UP-TO-DATE

TABLES

OF

Imperial, Metric, Indian and Colonial

WEIGHTS AND MEASURES

SIMPLE SUGGESTIONS FOR METRIC ADOPTION

IMPERIAL DECIMAL COINAGE

FOREIGN, INDIAN, AND COLONIAL MONEYS

STANDARD TIME, MENSURATION, INTEREST

SPECIALLY PREPARED MAPS

METRIC MEASUREMENTS APPLIED TO OUT-DOOR GAMES

COMPILED AND WRITTEN BY

ALFRED J. MARTIN

Fellow of the Surveyors' Institution, England

LONDON

T. FISHER UNWIN, 11, PATERNOSTER BUILDINGS, E.C.

1904

PRACTICAL RELATIONS OF BRITISH PRIMARY UNITS AND METRIC DENOMINATIONS.

(Inserted here for quick reference.)

YARDS TO METERS	Deduct
BI-POUNDS (2 lbs.) TO KILOGRAMS ...	10 per cent.
BI-GALLONS (2 gals.) TO DEKALITERS	or $\frac{1}{10}$th.

For the reverse of any of the above cases, "add" 10 per cent.

With the Weights and Measures to look at, these rules will appear even simpler, and unnecessary after the transition period, when all Books of Tables will be needless.

EXAMPLES OF MENTAL CALCULATIONS :—

11 yards = 10 meters.
30 yards = 27 meters.
11 pounds = $5\frac{1}{2}$ bi-pounds = 5 kilograms (kilogs).
20 gallons = 10 bi-gallons = 9 dekaliters (dekals).

---

20 meters = 22 yards (= Cricket pitch).
100 „ = 110 „ (= Football ground).
4 kilogs = $4\frac{1}{2}$ bi-pounds = 9 pounds.
8 dekals = 9 bi-gallons = 18 gallons.

CONTENTS.

PART II

NOTE.—*Numerous Cross-References are given, and a few repetitions occur, enabling one to start reading the book at almost any part. But if a study of the whole subject is to be made, it is advisable to read the matter in the order in which it is written; in which case the references to other pages can generally be ignored.*

INTRODUCTION

"That it is advisable to adopt the Metric System of Weights and Measures for use within the Empire, and the Prime Ministers urge the Governments represented at this Conference to give consideration to the question of its early adoption."
(*Resolution at Colonial Conference*, 1902.)

A RESOLUTION of such transcending importance could not have been passed by prominent Statesmen gathered together from every part of the Empire, unless they knew practical effect could be given to it. To realise how near at hand, therefore, this reform is, it is as well to follow the history of our Weights and Measures in bygone periods.

Probably the weights and measures in use throughout the British Isles had a common genesis, but from a number of circumstances, including the conquest of the inhabitants by various races, differences arose, and inter-communication being bad, they became accentuated. Even locally the measures became corrupted, so that there were, for example, three different gallons for ale, wine, and beer.

But as the race developed into a homogeneous body, Reform after Reform took place, until eventually, by introducing units corresponding as nearly as possible with various local denominations, a code of weights and measures was established throughout England. In the process, however, not only did every vestige of a regular system of multiples between the units disappear, as in the decimal gradations of the old English mile, hundred-pound weight, bushel, &c., but the measures of extension, weight, and capacity entirely lost that inter-relationship which is so essential if weights and measures are to fulfil their proper functions.

We need not trace all the reforms, but only note the principal ones in comparatively recent years.

In the Weights and Measures Act of 1824 an important step was

taken to regain our lost position. Proceeding on the lines of the Metric System, sec. 6 directed that the Imperial gallon should be made equal to 10 pounds weight of water (but unfortunately the gallon was not decimally divided), and the same Act cut down the Avoir. lb. from 7,008 grains to 7,000.

In the same year, the change of the Scotch Weights and Measures to English denominations was completed after some difficulty. The difference between the Scotch and English standard pounds was as 7,609 is to 7,000, and it is interesting to note that the Metric pound is 7,716 grains. It would have been better, therefore, if the English pound had given way to the Scotch pound.*

Between 1824 and 1835 the greatest change occurred, Imperial measure replacing Winchester measure, and the varying ell was replaced by the statutory yard. The Winchester bushel had finally disappeared in 1841 without strong opposition.

The most remarkable change, perhaps, occurred by evolution more than legislation, between the years 1841 and 1855, during which period the old Anglo-Saxon commercial or Avoirdupois weight was almost completely substituted for the old Norman or statutory Troy weight.

Certain anomalies continued to exist though, such as the varying stone for glass, meat, &c., and the different lengths of the mile, until the 1878 Act confirmed certain standards, abolished all Troy weights except the Ounce (which was then divided decimally, and declared to be a weight derived from the Avoir. pound), and made illegal all customary and local measures and the use of "heaped measure," which last reform in itself was a great change.

In the meantime, similar changes had taken place in the Colonies, such as the abolition of the Winchester bushel, Scotch ell, Dutch gallon, the French toise and ell in Canada, &c.

During the quarter century following the illegal customary and local measures have fast disappeared, and there has been a growing practice, especially in the Dominions beyond the Seas, to still further simplify the weights and measures, and to take merely the "Primary Units" defined in the English Acts, namely, the Yard,

* The partially surviving Scotch acre is also almost a Metric equivalent (½ hektar). This is not so much a coincidence as it is an indication that the Scotch kept their standards truer to the Continental originals than the English, who slowly diminished theirs, for Metric denominations were made to approximate with the old ones in France, Holland, &c.

they have ignored the existence of primary units as distinct from subordinate denominations.

It will therefore be seen that under the various headings of "Imperial" Measures* in this book, only the units authorised by the Weights and Measures Acts of 1878 and 1897 are given, and the Primary Units are emphasised. In this way, the old Cloth Measure, nearly all the old names of Wool Weights, the Troy pennyweight and pound, the old Apothecaries' Weight, the old Bread quantities instead of weights, the barleycorn, strike, pottle (Irish), and other obsolete weights and measures have been either left out or separately shown as Colonial and sometimes as old denominations, and the Act of Parliament relating to same quoted for corroboration.

Even with these omissions, however, there are many absurd complications and intricacies in our present fractional system, or rather want of system. All these have been tabulated,† and they should be thoroughly realised by the present and rising generations, so that the need for reform is seen, and that when it comes it will be an *actual* as distinct from a mere *legal* reform.

The inclination of referring to the primary units only, shows the time is ripe for the reception by the people of a system of weights and measures in which primary units only are used, with prefixes (if desired) as they proceed in regular multiples. That this regular multiple should be ten, as in counting, and as used in all other nations, is pointed out on pages 117 and 118; but to meet the wishes of supporters of the Binary theory, the Board of Trade standards could also include "subdivisions" of the *primary units* into eighths for certain trades, *e.g.*, Draper's measure. But binary "multiples" are not required, *e.g.*, in land surveying.

It should be noticed that in the last few years a decimalising process has been going on in many trades. To decimalise the present British primary units, however, only assists us in arith-

* The description of "Imperial" was first applied to our statutory Weights and Measures in 1821, and has so far been confined to the ordinary denominations. In this book it is used to distinguish from certain Colonial and other denominations "all" the statutory denominations in use in the United Kingdom since the Metric Act of 1897.

† See pages 48; 70 (second footnote); 74; 80; 81 and 82; 87 and 88. These amazing intricacies facilitate not only errors, but fraud; and when conjoined make our standards of pressure, &c., almost surpass utility.

metical calculations, without benefiting our trade with Foreign Nations, in nearly all of which the decimal Metric System is established, and without giving the yard any affinity to the pound and the gallon. By a fortunate coincidence, though, if each of our Primary Units were increased about "10" per cent., we should obtain a yard equal to the meter, a pound equal to the half-kilogram,* and a gallon equal to the half-dekaliter, with the advantage that all our primary units would be inter-related. Even this reform by itself would be an immense gain. To say it is too difficult of accomplishment is to admit that our race has not the adaptability it possessed from 1824 to 1884, nor the intelligence of the Japanese. The "double-pound" or "bi-pound" would then equal 1 kilogram, and the "double-gallon" or "bi-gallon" would equal 1 dekaliter. The old name of yard could be retained prefixed as follows: milli-yard, centi-yard, metric-yard, &c.

The easiest way of explaining what the adoption of the Metric System would mean, to individuals who have been accustomed to use Imperial denominations from childhood, is, therefore, that a slight increase would be made in the primary units, which would then be decimalised. It would be preferable, of course, for these two adjustments to take place simultaneously.

Old names would die hard, but a good method of securing the change would be to insert a Schedule to the Act, defining in Metric terms the values of certain old denominations, which would also relieve retailers of all responsibility for supplying articles by metric weight or measure when an Imperial denomination was, "through force of habit," asked for. For example, a pound could be defined as meaning in future ½ kilogram;* ¼ lb. or 4 ozs. as 1 hektogram; a cwt as 50 kilograms (110¼ lbs. or Metric 100 pounds); a hand defined as a decimeter; a foot as 3 decimeters; a pint as ⅛ liter; a reputed quart as ¼ liter; a quart as a liter; the Scotch cran as 42½ liters; a diamond carat as of "at least" 200 milligrams; the pearl grain as of "at least" 50 milligrams; and so on. The old names would no doubt be abandoned in time, especially as in these days all the large undertakings, such as Railways, would discard them in all dealings with their customers.

So puzzling is our present system of Weights and Measures, that from 1860 onwards, hardly a year has passed by without a Royal

* Une livre métrique ou demi kilogramme.

Commission or a Select Committee of the House of Commons having been appointed to inquire into its general effect, or its effect on particular trades.

That the reform is really urgent is evidenced too by the fact that since about 1897 the Colonial Conferences, Colonial Parliaments, Chambers of Commerce in all parts of His Majesty's Dominions (all of them in the British Isles), Trades Unions and Councils, County Councils, many Town Councils, Educational Authorities, National Union of Teachers, Scientific Societies, the Incorporated Society of Inspectors of Weights and Measures, the Institutions of the Professions and Trade Associations, &c., have passed resolutions favouring the compulsory use of the International Metric System for all purposes at an early date. The Colonies are sure to make the change soon, but it is better to work the change from the heart of the Empire than from its extremities, if only the Mother Country will "wake up" soon. Already about 300 Members of Parliament have signified their approval to the change.

Although the reform has been repeatedly advocated by Select Committees, &c., since 1860, Parliament has so far only made feeble attempts to introduce the system by enactments, without having it used in the Government Departments.

In 1864 was passed "An Act to render permissive the use of the Metric System of Weights and Measures." The Preamble of the Act points out that it is expedient to legalise the use of the Metric System "for the Promotion and Extension of our Internal as well as our Foreign Trade, and for the Advancement of Science." After reading the name of the Act and the candid admission in the Preamble, we might have expected something better than that the Act could only be used on paper, *i.e.*, invoices, &c., but the actual weights were not authorised.

In 1869 the Standards Commission, in their second report, recommended the permissive use of the system in Trade.

In 1871 Canada adopted similar legislation to that of the United Kingdom.

In 1878 the Weights and Measures Act embodied the 1864 Act, and therefore repealed it, and by Sec. 38 the International Metric System, still allowed for the purposes of science and manufacture, was not yet permitted for the purposes of Trade. A table of equivalents was given in one of the schedules. The imperial yard being of bronze and true length at 62° Fahr., whilst the International pro-

totype meter is of iridio-platinum and true at 0° Cent., and the standards being compared at the same temperature instead of at the true temperature of each, the equivalents were useless for accurate scientific operations.

In 1889 another Weights and Measures Act authorised the Board of Trade, if it thought fit, to deposit copies of International Metric Standards with Local Authorities, who had no voice in the matter.

In 1889 and 1894 the International Committee of Weights and Measures delivered to Great Britain her three copies of the International prototypes.

In 1895 another Select Committee of the House of Commons on Weights and Measures reported in favour of immediately making the system "permissive" for all purposes, and "general" or compulsory after a lapse of two years.

Thus in the year of the Diamond Jubilee, a year of great Imperial enthusiasm, the International Metric System was made *permissive for "all" purposes* by the Weights and Measures Acts of 1897. It was still left optional, though, with the Board of Trade, whether Local Authorities should keep Metric standards, whereas if they had been supplied the Local Authorities at Government expense, and exhibited in the Town Halls, &c., throughout the country, we should most probably all be using the International system now, but perhaps with the better series of 6, 3, 2, 1, instead of 5, 2, 2, 1 (see p. 115).

In 1898 Orders in Council (dated May 19) substituted for the 1878 table of equivalents, a new table of comparisons of the International denominations with the British, with each standard at its true temperature.

In 1902 the Cotton Trade abandoned the binary system for decimal subdivision. In the same year the resolution which opens this Introduction was passed.

In 1903 the Parliaments of the Australian Commonwealth, New Zealand, and Cape Colony, and the Fifth Congress of the Chambers of Commerce of the Empire held in Montreal, passed resolutions urging the Imperial Parliament to pass a compulsory Metric System Act (the wording in one case was perhaps not quite so definite), and the New Zealand Parliament also passed an Act enabling the Metric System to be adopted there by Proclamation, as soon as England wakes up.

In 1904 a Metric System Bill (compulsory adoption) will be

introduced to Parliament, when it is anticipated that the Government will be alive to its responsibilities.

The 1897 Act was one of those kind of reforming Acts which, if it was to be of any use whatever, required propagating, not only by the Educational but by all Government Departments, assisted financially by Parliament. No financial aid has been provided, nor the use of the Act encouraged by the Legislators who gave it birth, and it has not been embraced by the people, who cannot individually adopt it. Suggestions are offered how the required encouragement can be given, and the benefits of the system utilised in the Government Departments.

We must not allow the interests of the whole community, or of the component parts of the Empire, to say nothing of the education of the children, to suffer because of a temporary inconvenience perhaps in our own affairs or parish.

Apart too from handicapping ourselves by retaining our present unlearnable system, the gravity must also be considered of introducing it in countries which now are and in the near future may be committed to our charge, when we must eventually and soon adopt the World's standards if we are to maintain our position as one of the greatest civilising and commercial Powers. Let us therefore for a moment turn our thoughts to our responsibility in India.

A Metric Act was passed by the Government of India in 1870, to consolidate the multitudinous systems in vogue there, but this was vetoed at Whitehall by the Secretary of State for India, because the measures of extension were included.

In 1871 another Metric Act was drawn up, on the supposition that England and Canada were about to adopt the system, but this Act excluded the measures of extension from its operation. The murder of the Viceroy at the time, and the want of a bolder policy since on the part of the Imperial Parliament, has frustrated the use of this Act, which has not yet been gazetted. Its purpose was to unify the existing ser weights and ser measures, which average respectively 1 kilogram and 1 liter. The result has been serious, and India to-day is still waiting for a uniform system of Weights and Measures of Capacity throughout its vast extent, for it is perhaps impracticable to make the Metric System compulsory there before it is so in England, or to introduce the entire Imperial system, or place existing native weights and measures on a con-

sistent basis, when we are on the eve of a change in England, which would necessitate a second alteration.

But some things cannot wait, so in 1899 a Measures of Length Act was passed, attempting to consolidate the Guz into the Imperial Yard, fractionally divided. But apparently the Act does not refer to Land Areas, and it is interesting to note, as shown on pages 161 and 162, that the Hektar is the best possible land unit to replace the Biga.* The Metric system of count has however been recently authorised for imported woollen and silken yarns.

Whilst England has been acting half-heartedly in the matter, and extensive territories with vast populations added to the Empire, including Burma, Nigeria, &c. (see Maps inserted and "Anglo-African Empire"), with the result that the cumbrous British system has "followed the flag," the other nations of the Earth have forged ahead, held an International Conference on Weights and Measures, and adopted the Metric System : it is almost needless to add that none have regretted the course taken, as is shown by our Consular Reports.

This superior and decimal system is based on the same principle as existed among the Babylonians 2,000 years B.C., namely, a relationship between the measures of extension, capacity, and weight, a method that exists to-day in India. It is used by British Scientists, Electricians, in Pharmacy, the Yarn Trades, in several Professions and Trades, and for Sports in Up-to-Date Schools, whilst Parish and Town Maps of the Ordnance Survey are only waiting to receive the imprint of the Metric Scale, as shown on pages 144 to 147.

The last remark will no doubt surprise many who believe that nothing will be harder to reform than our Land Measures. A Surveyor, in reply to the question why the Metric Scales could not be shown on our Ordnance Maps, recently said : "There is a method in our madness. Think if England were invaded how confusing the scales shown on the Parish Maps, for example, would be to the Foreigners. What would such scales as 1 inch to 3·156 chains or 25·344 feet to a mile convey to their minds?" The response was, "You admit madness, then, but what about the method that puts these scales on for the guidance of our Volunteers (and children in

* The Hektar also compares favourably with the Acre, Cape Morgen, and Quebec Arpent, being a multiple in each case (page 49). See also old Scotch, Irish and Welsh Acres.

schools), and for the benefit of the Foreigner also inserts the little figures $\frac{1}{2500}$, which Europeans of all nationalities would at once recognise as 4 decimeters to the kilometer?" This omission of the Government to use the Metric System in one of its Departments, and when so easily applied, is one of several which could be instanced.

Attention should be called to the detrimental influence the spelling hitherto often used for metric names has had. Throughout this little work the words *mètre*, *litre*, and *gramme* have been Anglicised into "meter," "liter," and "gram," the spelling adopted by the Decimal Association,* a Society which has done much to bring the compulsory adoption of the Metric System within the range of practical politics. The pronunciation recommended for meter is as in gas-meter, &c., and for liter, *leeter*. The spelling of the prefix *hecto* and the *are* measure are as in the Report of the Select Committee of the House of Commons in 1895, and according to pronunciation thus, "hektoliter" and "hektar." For phonetic reasons also, as well as for symmetry of the Greek prefixes, the prefix *deca* is spelt *deka*, a spelling which also distinguishes it from the soft-sounding Latin prefix, *deci*. There can be no more objection to these methods than to the transliteration by the French of the Greek word *chilioi* into *kilo*, or the use of the words "square" or "superficial" in lieu of *carré*, or the English pronunciation of the word "Paris," although similarly spelt.

The question of the Coinage of the realm has also received careful consideration. It has already been pointed out that in the United Kingdom and Canada, Troy weight consists solely of the Ounce and its decimal derivatives, and can therefore only be used for the precious metals, the more delicate Avoir. grain being employed for weighing precious stones. But even the use of the Ounce could be dispensed with by defining the standard Sovereign as of exactly 8 grams,† and thus not only would one great barrier to the adoption of weights with Metric equivalents be removed, but encouragement would be given to substitute the $\frac{1}{2}$ kilogram for the Avoir. pound, the gallon (of 10 Avoir. pounds) following suit.

* London Chamber of Commerce, Oxford Court, Cannon Street, London, E.C.

† Present standard weight, 7·98805; maximum, 8·00101: minimum, 7·93787. Abolition of Troy Weight was first recommended by the Standards Commission in 1870, and the Metric System has been already employed for coinage by the Mint, as the easiest system, the occasion being the large issue of copper "cash" to Hong Kong and China.

This adjustment of the Sovereign, which, as shown on page 94, could be effected without any public loss or inconvenience, is of even greater importance from a coinage point of view, owing to the fact that nearly all Foreign gold coins are based on a Gram weight of gold, and, moreover, in nearly every country there is a gold coin approximating in value to the Sovereign, as shown in a specially prepared Table of Foreign Monies.

The extreme urgency of decimalising our coinage (recommended by Select Committees of the Houses of Parliament), as a set-off against the continually growing Latin Union, is also treated with. All that would be necessary to enable us to improve our system of coinage count, would be the alteration of the name of the sixpence, the minting of another coin to replace the threepenny pieces, and the issuing, as time and circumstances permitted, of 25 new bronze coins for every 24 handed in. Another specially prepared Table is inserted to illustrate how the new farthing would have affinities throughout the World. This reform, if carried out soon, would be the final step towards securing the British Sovereign as the International Monetary Unit instead of the Franc.

The decimalising of the Florin also forms the only practical solution of the compulsory adoption of the Metric System by the Railway Companies, as shown under "Combined effects" on page 148.

The author maintains that if the Metric System were made compulsory for Railway Companies; were adopted by the Bank of England; and shown on our Ordnance Surveys; that within a very short time the system would be generally adopted throughout the Empire.

Under "Time" comment is made upon the Statutory Quarter Days and the more equitable division of the year made in most of the Colonies. Under "Standard Time" a suggestion is made for universally referring to Greenwich Time on all Cablegrams, to obviate the paradox of receiving a telegram at an earlier hour than it was sent.

The close of the last century will always be noted (*a*) for the acceptance of the International Metric System of Weights and Measures by the people of practically all Civilised Nations except the British; (*b*) the coinage of monetary units alike in weight and fineness (although generally differing in name) in eleven European countries; (*c*) the introduction of the British Sovereign as the gold

unit in Indian coinage; (*d*) the almost universal employment of Greenwich Meridian; (*e*) the change by all Nations to Greenwich or Standard Time.

These last two circumstances should prevent Britishers from hesitating to adopt a better system of weights and measures simply because it has first been taken up by Foreigners, although originally suggested by an Englishman (James Watt), and the second and third circumstances should inspire us with the determination to make our Coinage the world's prototype before it is too late. Thus by bringing ourselves into line with our competitors in the one case, and inducing them to follow us in the other, we should restore our prestige as early in this century as possible, and make "One Language in Commerce" an accomplished fact.

This book is divided into Two Parts. The first is devoted to its main purpose; the second to matters indirectly connected with coinage, time, weights and measures, and their practical applications, useful in the Office, Workshop, Class-room, Recreation Ground, and Home, with a few particulars concerning the Empire which would be affected by the Reforms advocated.

It has often been remarked how scattered the British Empire is. For the first time a "Horseshoe" Map of the Indian Ocean appears. Its purpose is to show up how our weights, measures, and coinage vary, and also to indicate the lines on which the greater part of the Empire is destined to become consolidated, by purchase or exchange with other countries, of their territories lying within the horseshoe. A universal system of Weights, Measures, and Coinage will then be more imperative than ever.

To those interested in South Africa the author would point out that this book is, if not the only book, the only cheap book giving decimal comparisons of the "Cape" Land Measures, with the Imperial and International Land Measures. Africa is a Continent in which greater developments are taking place now, and will be in the near future, than in any of the other Continents: a specially prepared Map of the Powers in Africa is therefore included in this pocket-book of information. The part coloured Red shows at a glance where we are introducing to the Black Populations our appalling commercial language, or, in the case of East Africa, the Indian Weights and Measures. The other coloured parts alongside us show where all the other nations are spreading the knowledge of a logical, more useful, and infinitely easier method of

exchange. Lines of longitude are inserted every 15° to illustrate Standard Time, also referred to under "The Anglo-African Empire."

Lastly, plans of Outdoor Games, showing Metric Measurements as well as Imperial, have been inserted, with the hope that sportsmen will bring into the field of play a subject that has remained too much in the dusty archives of Public Libraries or the dry "Transactions" of the learned societies. Nothing would more conduce to familiarise the imagination of the people with the Metric Denominations than their employment in the games they love.

The Author trusts this little work will be found useful as a handbook of reference to Members of the Imperial and Colonial Parliaments desiring reform, to Landed Proprietors, Professional and Commercial Men, Inspectors of Weights and Measures, Travellers by Land and Sea, Teachers, and others.

It has been compiled from Reports laid before the Imperial Parliament, from Imperial, Colonial, and Indian Acts of Parliament, the British Pharmacopœia, and from information kindly furnished by the India Office, the Colonial Office, and many Professional and Commercial friends. To all these the Author begs to tender his best thanks.

THE SURVEYORS' INSTITUTION,
WESTMINSTER, S.W.
1/1/'04.

PART I

IMPERIAL ACTS OF PARLIAMENT

These may be seen at the British Museum, and generally in Public Libraries, Assize Courts, &c. A "Chronological Table and Index to the Statutes" (in which all Acts relating to Weights and Measures are indexed) may be obtained of His Majesty's stationers (as below), the volume of Statutes in force costing 10s. 6d. Separate copies of Acts may be purchased, either directly or through any bookseller, from Eyre and Spottiswoode, East Harding Street, Fleet Street, E.C.; or Oliver & Boyd, Edinburgh; or E. Ponsonby, 116, Grafton Street, Dublin.

The student should be aware that the system of referring the date of an Act solely to the year of a sovereign's reign, *e.g.*, 41 and 42 Vict., instead of to A.D., has in many books caused the date of an Act to be quoted one year from its actual date. A Table of Kings and Queens of England is inserted pages 226 and 227.

WEIGHTS AND MEASURES.

The Administration of the Imperial Weights and Measures Acts is vested in the Board of Trade, Whitehall Gardens, London, S.W. (Standards Office, 7, Old Palace Yard, S.W.)

Act 1878 (*referred to in subsequent Acts as the "principal Act"*).

SECTIONS 10 to 15 deal with the standards of weights and measures, and these standards are mentioned under the respective tables in this book, and on page 117.

SECTION 17 relates to measures of capacity, and is referred to in this book on page 59.

SECTION 19 enacts that "No local or customary measures, nor the use of the heaped measure, shall be lawful." "Any person who sells by any denomination of weight or measure other than one of the Imperial weights or measures, or some multiple or part thereof, shall be liable to fine. . . ."

SECTION 20 relates to Troy and Apothecaries' Weights, and is referred to in this book on pages 78, 84 and 85.

SECTION 21. A contract or dealing shall not be invalid or open to objection on the ground that the weights or measures expressed or referred to therein are weights or measures of the metric system, or on the ground that "decimal subdivisions of imperial weights and measures," whether metric or otherwise, are used in such contract or dealing.*

SECTION 30. Weights made of lead or pewter must be wholly and substantially cased with brass, copper, or iron, and marked "cased"; but a plug of lead or pewter may be inserted if necessary for the purpose of adjustment, and for affixing thereon the Inspector's stamp.

SECTION 38 permitted the use of metric weights and measures for the purpose of science or manufacture, or for any lawful purpose not being for the purpose of trade within the meaning of this Act (Purposes made general by 1897 Act).

SCHEDULES 1 and 2 describe the standards and enumerate their multiples and sub-multiples.

SCHEDULE 3, giving the Imperial equivalents of metrical weights and measures, and the converse, is repealed by Act 1897, section 2, part 2.†

The Act also provides for local ordinary standards, but not Metric, being kept by local authorities; for the appointment of local inspectors; their duties, &c.

For sections referring to Coin-Weights, see page 26.

Act 1889.

SECTION 2. The Board of Trade may "if they think fit," at the expense of a local authority, deposit with the local inspector of weights and measures, copies of any of the metric standards.‡

* This section permitted the use of the Metric System (also decimal parts of any Imperial denomination, whether primary or derived) upon Invoices, &c., but from 1878 to 1897 it was illegal to weigh or measure goods with Metric denominations, even for the export trade with Metric countries.

† For reason, see Introduction, page 13.

‡ AUTHOR'S NOTE.—If this had been made compulsory and at Government expense the use of the Metric System would have made much more progress.

SECTION 6 enacts that "The Board of Trade shall, from time to time, cause such new denominations of standards for the measurement of electricity, temperature, pressure or gravities, as appear to them to be required for use for trade, to be made and duly verified." *

SECTION 20 (1). All coal shall be sold by weight only, except where by the written consent of the purchaser it is sold by boat-load or by waggons, or tubs delivered from the colliery into the works of the purchaser.

SCHEDULE 1 gives the Fees for verifying and stamping Weights, Measures, and Weighing Instruments.

Act 1897.

SECTION 1 declares egal the use of Metric Weights and Measures for "every" purpose.

SECTION 2, part 1, provides that the Board of Trade standards shall include standards of the meter and kilogram; and part 2, that, by Order in Council, a new table of metrical equivalents may replace the one given in schedule 3, Act 1878.†

ORDERS IN COUNCIL, Nos. 410 and 411 of 1898 (Eyre and Spottiswoode, 1d.) were dated May 19, 1898.

VARIOUS ACTS.

Burgh Police (Scotland) Act, 1892, Sections 277, 416 to 427, 430 and 431.

The Medical Act of 1858.

This refers to the W. and M. used in Pharmacy (see page 77).

The Bread Acts.

These are all worded the same, except that the 1822 Act refers to London only, the 1836 Act to Great Britain, and the 1838 Act to Ireland; the sections too are a little differently numbered.

* The Standards Office has not yet (1903) deemed it necessary to issue standards of temperature and pressure. For statutory Electrical Standards see page 188.

† For reason see page 13.

Act 1836.

SECTIONS 3 and 4. Bakers may "make" Bread of any Weight or Size, but must "sell" it by weight only, except French or Fancy Bread and Rolls.*

SECTION 5. The weights used must be the Avoir. pound or gradations of same only. By the W. and M. Act, 1897, Metric weights may be employed.

W. and M. Act, 1889.

SECTION 32. A baker or his servant may refuse to weigh bread sold from the cart unless the "purchaser" requests him to.

The Colonial Acts also establish the sale of bread by weight.

In Scotland (Burgh Police Act, 1892, sec. 427) and in Newfoundland **the weight of bread must be stamped on the loaves.**

Corn Returns Act, 1882.

SECTION 8 provides that where returns of purchases of British Corn are made to the local inspector of Corn Returns in any other measure than the Imperial bushel or by weight or by a weighed measure that officer shall convert such returns into the Imperial bushel, and in the case of weight or weighed measure the conversion is to be made at the rate of sixty Imperial pounds for every bushel of wheat, fifty Imperial pounds for every bushel of barley, and thirty-nine Imperial pounds for every bushel of oats.

COINAGE.

Coinage Act, 1870.

This is a consolidating Act.

SECTION 3 and the FIRST SCHEDULE † fix the standard fineness,‡ and the standard weight and remedy allowance in Grains and Grams, of all coins then or thereafter to be minted; also the least current weight of gold coins.

---

* See page 75. † Printed as amended by the 1891 Coinage Act.
‡ For explanation of these terms see page 88.

SECTION 4. Legal tender: standard gold coins to any amount; silver coins to £2; bronze coins to 1s. Paper currency according to Acts relating thereto.

SECTION 5. Prohibits other coins and tokens. Penalty £20.

SECTION 6. All contracts to be made in Imperial denominations, unless in those of some British Possession or Foreign State.

SECTION 8. Standard "Gold" Bullion * shall be assayed, coined, and delivered without any charge for such assay or coinage or for waste in coinage. Bullion inferior to standard can be refused, but if superior to standard, the owner to receive additional coins proportionately.

SECTION 11† (Regulations by Proclamation).

It shall be lawful for (His) Majesty, with the advice of (His) Privy Council, from time to time by proclamation to do all or any of the following things; namely,

(1) To determine the dimension of and design for any coin:

(2) To determine the denominations of coins to be coined at the Mint:

(3) To diminish the amount of remedy allowed by the first schedule to this Act in the case of any coin:

(4) To determine the weight (not being less than the weight (if any) specified in the first schedule to this Act) below which a coin, whether diminished in weight by wear or otherwise, is not to be a current or a legal tender:

(5) To call in coins of any date or denomination, or any coins coined before the date in the proclamation mentioned:

(6) To direct that any coins, other than gold, silver, or bronze, shall be current and be a legal tender for the payment of any amount not exceeding the amount specified in the proclamation, and not exceeding five shillings:

(7) To direct that coins coined in any foreign country shall be current, and be a legal tender, at such rates, up to such amounts, and in such portion of (His) Majesty's dominions as may be specified in the proclamation; due regard being had in fixing those rates to the weight and fineness of such coins, as compared with the current coins of this realm:

* The free coinage of silver has not been allowed since 1816.

† This section is quoted word for word, as apparently it enables Decimal Coinage to be introduced by Proclamation (see page 109).

(8) To direct the establishment of any branch of the Mint in any British possession, and impose a charge for the coinage of gold thereat; determine the application of such charge; and determine the extent to which such branch is to be deemed part of the Mint, and to which coins issued therefrom are to be current and be a legal tender, and to be deemed to be issued from the Mint:

(9) To direct that the whole or any part of this Act shall apply to and be in force in any British possession, with or without any modifications contained in the proclamation:

(10) To regulate any matters relative to the coinage and the Mint within the present prerogative of the Crown which are not provided for by this Act:

(11) To revoke or alter any proclamation previously made.

Every such proclamation shall come into operation on the date therein in that behalf mentioned, and shall have effect as if it were enacted in this Act.

SECTION 12 relates to the "trial of the pyx," or pix, *i.e.*, trial of the weights and qualities of sample coins previous to issue.

SECTION 14. The Chancellor of the Exchequer is Master of the Mint.

SECTION 16. Standard trial plates, &c., to be in the custody of the Board of Trade.

SECTION 17. (Partly repealed by Sec. 8, W. and M. Act, 1878; see schedule thereto). The Mint copies of standard weights to be compared annually with the Board of Trade standard weights.

W. and M. Act, 1878.

(Sections relating to "Coin-Weights," and therefore only indirectly to "weights of coins"; that is to say, the weights referred to below may be made of brass or other metal. The Board of Trade standards are made of gold, palladium, silver, and bronze.)

SECTION 8. Coin-Weights of other denominations than those mentioned in the Second Schedule, may be ordered to be made at the discretion of the Board of Trade (see Coin-Weights, page 95).

SECTION 31. Coin-Weights not less in weight than the weight of the lightest coin for the time being (legally) current, shall be verified by the Board of Trade, and not locally.

SECTION 34. The custody of standards remains with the Board of Trade.

SECTION 36. Quinquennial verification of Board of Trade standards with those standards walled-in in the Houses of Parliament.

SECTION 39. Regulates the Fees for verification of Coin-Weights.

Act 49 and 50 Vic., chap. 41.

SECTION 42. Prohibits the importation of silver coins of the realm below standard weight.

ACTS OF PARLIAMENT, &c., ON WEIGHTS AND MEASURES OF THE PRINCIPAL OVER-SEA DOMINIONS.

GENERAL REMARKS.

The 1878 W. and M. Act of the Imperial Parliament, in so far at least as it relates to the standards of weights and measures, is practically the basis of all the Weights and Measures Acts of the principal Colonies, with the exceptions and additions hereinafter mentioned or referred to in the Tables.

It is often not clear from the Acts themselves whether the Metric System is *authorised* in a particular Colony or not, although, speaking generally, it is considerably *used* in the Colonies. That is to say, by some Acts the only standards permitted are those mentioned in the Act or Schedule thereto unless others are added by the Governor, Commissioner of Inland Revenue, or other officer. Other Acts allow the standards "from time to time" in use in the United Kingdom, and therefore undoubtedly include the Metric, whilst in some Colonies Acts passed long ago, and which allowed all standards "now" in use in the United Kingdom, have been included in Consolidated Laws of recent date without alteration in the phraseology. There are districts, too, which adopt the same weights and measures

as from time to time "in use" (but not necessarily authorised) in adjoining Colonies. In one Crown Colony laws passed in England become law, under certain conditions, in the Colony if circumstances permit. And so on.

When we remember that other countries have considered their weights and measures a sufficiently important matter upon which to hold an International Commission, the subject appears urgent enough for an Inter-Colonial Conference to meet solely upon. If such a Conference drew up a Model Weights and Measures Bill for submission to the respective Governments, the weights and measures in every corner of the Empire would be placed on a business footing, for apart even from adopting a decimal system, it is of consequence that—(*a*) The standards should be the same; (*b*) made of the same metals and equal alloy;* (*c*) be standard at practically the same temperature; (*d*) with similar gradations; and (*e*) identically described. It would perhaps be even more practicable and useful to send Delegates from the Over-Sea Dominions, to form the first "Imperial Council" empowered to pass a Metric System Act, applicable to the whole Empire.

Copies of all Acts, Proclamations, &c., affecting Weights and Measures in the Colonies, with Index, may, by permission, be referred to in the Private Library of the Colonial Office, Whitehall; also in the Public Libraries belonging to the respective Governments. They should be purchasable of the respective Government Printers, whose names are given below; but it will be often found that Acts are "out of print."

CANADA (Gov. Printer: S. E. Dawson, Ottawa).

Chapter 104 of Revised Statutes, 1886.

SECTION 12. In the Province of Quebec the measures of length and superficies for all lands comprised in those parts of the Province originally granted under the seigniorial tenure, shall be French measures.† . . . Provided that the provisions of this section shall apply only to territorial measurement. The French "toise" and "ell" (*aune*) are declared illegal.

* Preferably, for the sake of comparison, those used for the meter, kilogram, &c. See first footnote, page 117.

† Not the metric; see pages 43 and 46.

SECTIONS 23 and 35 are identical in substance with SECTIO and 38 of the Imperial Act of 1878,* referring respectiv Imperial decimal denominations and Metric denomina for certain purposes.

SECTION 55. The capacity of casks containing liquids subj excise must be legibly marked on the casks in *gallon parts of a gallon*, before delivery to the purchase Chapter 17, 1889).

SCHEDULE 3 expresses the equivalents of standard denomina in metric terms.†

Chapter 30, 1898 } Statutes revising weights of standard bus
" 28, 1899 } bundles of hay, &c., also fixing measure
" 26, 1901 } of a barrel of apples and standard weigh other commodities.

NEWFOUNDLAND (Gov. Printer : J. W. Withers, St. John Newfoundland).

Chapter 102, of Consolidated Statutes to 1892.

SECTION 1. The standards are the same as were fixed in E land by 5 Geo. IV., chap. 74 (1824), an Act repealed s those standards were destroyed in the fire at the House Parliament in 1834.

The Colony's standards therefore include the old Troy pou no longer an Imperial standard, and the Troy ounce is still divi into dwts. and grains instead of decimally, as is correct England. The old heaped measure also still survives.

Otherwise the standards of the Colony are equal to the pres Imperial standards (which were made equal to those destroye but do not include the Metric.

COMMONWEALTH OF AUSTRALIA.

By "The Commonwealth of Australia Constitution Act," 19 (63 and 64 Vict., chap. 12), section 51, the Commonwealth Parl ment is empowered to make laws for the whole Continent

* See page 22.

† These are no longer scientifically accurate. The meter, for example, is giv as 1·09394 standard yards, whereas the actual meter is 1·093613 (Order Council, London, No. 411 of 1898).

respect to (para. 12) currency, coinage, and legal tender, and (para. 15) weights and measures.

AUTHOR'S NOTE.—*There is a great likelihood of Decimal Coinage being introduced shortly, and the Metric system being made compulsory after two years.*

In Western Australia the short cwt. and ton must be used for flour and certain other products, and, doubtless, this custom has extended to the other Colonies.

Victoria and Western Australia still make the Troy pound a primary unit; New South Wales and Queensland use the old dwt. and grain; South Australia (like the United Kingdom, Canada, South Nigeria, &c.) permits only the Troy ounce and decimal parts thereof.

New South Wales and Queensland allow "other weights and measures of the standard of the United Kingdom" from time to time to be deposited as standards by the authority of the Governor, and it should be noted that the Metric standards have been denominations for all purposes in the United Kingdom since 1897.

The weights of standard bushels somewhat differ throughout the Commonwealth (see Wheat, Barley, and Oats, page 74).

In four of the Colonies "some" aliquot part of the pound may be used in any sale.

The following are mostly from Consolidated Statutes:—

Victoria (Gov. Printer: R. S. Brain, Melbourne).
Weights and Measures Act, 1890.
SECTION 3. The "Winchester Bushel" and "Scotch Ell" abolished.

New South Wales (Gov. Printer: W. A. Gullick, Sydney).
Law 19 of 1898.

Queensland (Gov. Printer: J. C. Beal, William Street, Brisbane).
Law 34 of 1852.
Law 18 of 1898.
Agricultural Produce Act, 1866.

South Australia (Gov. Printer: E. Spiller, North Terrace, Adelaide).
Law 349 of 1885.

Western Australia (Gov. Printer : R. Pether, Perth).

Law 2 of 3 Will. IV. (repealed except Section 11, wei
bread).

Law 11 of 1899.

Tasmania.

Law 3 of 1834.

Law 29 of 1891.

NEW ZEALAND (Gov. Printer : John Mackay, Wellingto

Law 30 of 1868.

SECTION 3. The "Winchester Bushel" and "Scotch
abolished.

The short cwt. and ton are allowed for flour, &c.

The old Troy pound is still made a primary unit.

Law 27 of 1877 (Financial Arrangements Act), Section 9.

Law 7 of 1900.

Law of 1903. According to latest advices the foregoing
recently been repealed, but copies of the Act are no
available.

CLAUSE 25 of the Bill authorised the Governor to declare
"Proclamation," that the Metric Weights and Measures
be the only lawful weights and measures in the Co
from the date named in the proclamation, not sooner
January 1, 1906.

But strange to say, this Progressive Act does not pe
the use of the Metric System in the meantime, and it
retains the Troy Pound, and also the square perch, altho
the lineal perch is not mentioned. The bushel is only
ferred to in the schedule of fees for verification.

CAPE COLONY (Gov. Printer : Capetown).

Law 11 of 1858.

SECTION 2. The primary standards are the same as were fixe
England by 5 Geo. IV., chap. 74 (see notes on the Ne
foundland Act, page 29, and the "Short" Ton, page 70).

SECTION 3. The standard bushel is fixed at 2218·191 cubic inches, equal to 8 Imperial gallons.*

SECTION 8. All weights commonly called "Dutch weights," and the "Ell," "Old Gallon," "Schepel," and "Muid," are abolished and declared illegal; but nothing contained in the Act in regard to the measures of extension shall apply to any land, or any sale thereof.

SECTION 9. The "hundredweight" shall be taken to mean 100 lbs., unless agreed to the contrary.

SCHEDUDE: Decimal parts of the avoir. pound are allowed.

Law 9 of 1859 *(a short Act of one Section).*

The unit of land measure of the Colony is, and shall be, a foot of such length that one thousand of such feet shall be equal to one thousand and thirty-three English feet, as now by law defined and established for lineal measurements in England.

Law 15 of 1876.

Law 33 of 1895 (Public Markets Act).

Cereals, &c., above 50 lbs., to be sold at per 100 lbs.

NATAL (Gov. Printers: P. Davis and Sons, Pietermaritzburg).

Ordinance 11 of 1852.

The Municipal Corporations Act, Law 19 of 1872, Sections 66 to 70.

SECTION 70. The Imperial weights, scales, and measures of Great Britain shall be the standard weights, scales, and measures to be used in every borough.

Act 39 of 1884, Section 11.

AUTHOR'S NOTE.—*Apparently the Imperial standards "from time to time" may be used, and therefore inclusive of the Metric. The short cwt. and ton are customary, but apparently unauthorised. Standard weights are fixed for certain staple commodities.*

* In the United Kingdom in 1890, the Imperial gallon was declared to be 277·463 cubic inches; 8 of these would be equal to 2219·704 cubic inches.

THE TRANSVAAL.

"The Statute Law of the Transvaal," as translated by aut
(Waterlow and Sons, Ltd., Printers, London Wall, London, E.

Law 2 of 1874.

SECTION 2. The standards shall be the same as then exist
the Colony of the Cape of Good Hope and Orange
State, and the old system is abolished.

SECTION 6. ". . . nothing herein shall apply to any sa
land."*

SECTION 15 refers to "muids" and "buckets" abolished b
Market Authorities since the Annexation.

Municipal Proclamations and Ordinances have been publ
fixing the standard weight of the "bag" of certain s
commodities.

ORANGE RIVER COLONY.

"The Statute Law of the Orange River Colony," as translate
authority (Waterlow and Sons, Ltd., Printers, London
London, E.C.).

Law 25 of 1898.

SECTION 2. The standards shall be the same as then existir
the Colony of the Cape of Good Hope.

SECTION 15 abolishes the weights commonly called "D
weights," as well as the measures "Ell," "Bushel," "Mi
and "Old Gallon."

The Cape Land Measurements are used.

Municipal Proclamations and Ordinances have been publis
fixing the standard weight of the "bag" of certain st
commodities.

RHODESIA.

Ordinance 3 of 1891 (*Cape Government Gazette*, Septembe
1891).

The standards are the standard coinage, weights and meas
from time to time in "use" in the Colony of the Cape of G
Hope.

* The Cape Land Measurements are used, and latterly the Metric measurem
were often used for Mine Surveys, &c.

SECTION 3. The standard bushel is fixed at 2218·191 cubic inches, equal to 8 Imperial gallons.*

SECTION 8. All weights commonly called "Dutch weights," and the "Ell," "Old Gallon," "Schepel," and "Muid," are abolished and declared illegal; but nothing contained in the Act in regard to the measures of extension shall apply to any land, or any sale thereof.

SECTION 9. The "hundredweight" shall be taken to mean 100 lbs., unless agreed to the contrary.

SCHEDUDE: Decimal parts of the avoir. pound are allowed.

Law 9 of 1859 *(a short Act of one Section).*

The unit of land measure of the Colony is, and shall be, a foot of such length that one thousand of such feet shall be equal to one thousand and thirty-three English feet, as now by law defined and established for lineal measurements in England.

Law 15 of 1876.

Law 33 of 1895 (Public Markets Act).

Cereals, &c., above 50 lbs., to be sold at per 100 lbs.

NATAL (Gov. Printers: P. Davis and Sons, Pietermaritzburg).

Ordinance 11 of 1852.

The Municipal Corporations Act, Law 19 of 1872, Sections 66 to 70.

SECTION 70. The Imperial weights, scales, and measures of Great Britain shall be the standard weights, scales, and measures to be used in every borough.

Act 39 of 1884, Section 11.

AUTHOR'S NOTE.—*Apparently the Imperial standards "from time to time" may be used, and therefore inclusive of the Metric. The short cwt. and ton are customary, but apparently unauthorised. Standard weights are fixed for certain staple commodities.*

* In the United Kingdom in 1890, the Imperial gallon was declared to be 277·463 cubic inches; 8 of these would be equal to 2219·704 cubic inches.

THE TRANSVAAL.

"The Statute Law of the Transvaal," as translated by aut
(Waterlow and Sons, Ltd., Printers, London Wall, London, E

Law 2 of 1874.

SECTION 2. The standards shall be the same as then exist
the Colony of the Cape of Good Hope and Orange
State, and the old system is abolished.

SECTION 6. ". . . nothing herein shall apply to any sa
land."*

SECTION 15 refers to "muids" and "buckets" abolished b
Market Authorities since the Annexation.

Municipal Proclamations and Ordinances have been publ
fixing the standard weight of the "bag" of certain s
commodities.

ORANGE RIVER COLONY.

"The Statute Law of the Orange River Colony," as translate
authority (Waterlow and Sons, Ltd., Printers, London
London, E.C.).

Law 25 of 1898.

SECTION 2. The standards shall be the same as then existi
the Colony of the Cape of Good Hope.

SECTION 15 abolishes the weights commonly called "D
weights," as well as the measures "Ell," "Bushel," "M
and "Old Gallon."

The Cape Land Measurements are used.

Municipal Proclamations and Ordinances have been publis
fixing the standard weight of the "bag" of certain st
commodities.

RHODESIA.

Ordinance 3 of 1891 (*Cape Government Gazette*, Septembe
1891).

The standards are the standard coinage, weights and measu
from time to time in "use" in the Colony of the Cape of G
Hope.

* The Cape Land Measurements are used, and latterly the Metric measurem
were often used for Mine Surveys, &c.

BAROTSELAND.

Proclamation 18 of 1901, Clause 33 (*Cape Government Gazette*, 8370, September 10, 1901).

The Imperial standards are adopted, and therefore include the metric (W. and M. Act, 1897).

SOUTH NIGERIA (Gov. Press : Old Calabar, South Nigeria).

W. and M. Proclamation 7 of 1901.

SECTION 8. . . . and any weight being "any" part or multiple of any of the said avoir. weights may be used.

CEYLON (Gov. Printer : G. J. A. Skeen, Colombo).

Law 8 of 1876 as amended by Law 14 of 1878 (both proclaimed May 1, 1879).

SECTION 1. The standards and gradations are solely those mentioned in the Schedule of the Act, being the same as were established by 18 and 19 Vict., chap. 72, and 5 Geo. IV., chap. 74.

(See Notes on the Newfoundland Act, page 29.)

BRITISH GUIANA.

Ordinance 2 of 1851.

The standards are solely those mentioned in the Schedule, being the same as were fixed by 5 Geo. IV., chap. 74.

(See Notes on the Newfoundland Act, page 29.)

BRITISH HONDURAS.

Chapter 61 of the Consolidated Laws, published in 1887.

The only legal standards are the "ordinary" Imperial standards at present in use in Great Britain. But according to the Commissioner's Notes at the commencement of the Volume of Laws, under certain conditions, and if circumstances permit, an Imperial statute may come into force within the Colony after the lapse of twelve months from the date of the passing thereof in England.

AUTHOR'S NOTE.—*In this way the Metric System (Imperi* 1897) *may have come into force in the Colony, but the "ordinary" would probably not include the Metric stan although they were Board of Trade standards when the Laws Colony were consolidated.*

EXTRACTS FROM THE ACTS RELATING WEIGHTS AND MEASURES IN INDIA.

The Acts may best be referred to in the Record Office a India Office, Whitehall, London, S.W., which will also sup list of official agents throughout Europe from whom the Acts be purchased.

INDIA:*

Act 11 of 1870. (A vetoed Metric System Act.)

This was an Act to establish the Metric System of Weights Measures throughout India. It became law, but being veto Whitehall, by the Secretary of State for India, because it incl measures of extension, had to be withdrawn.

Act 31 of 1871. (An unsanctioned Metric System Act.)

"The Indian Weights and Measures of Capacity Act, 1 The Viceroy, Lord Mayo, was murdered before this Act was lished in the *Gazette of India*, and as some doubt seemed to whether the use of the Metric System was yet permissive Author wrote to the Secretary of State for India and received following reply, dated 8th September, 1903, through the Reve and Statistics Department :—

". . . . the Government of India has never put into force provisions of 'The Indian Weights and Measures of Capa

* Pitt's India Act, 1874, established the supremacy of the Presidency of "Ben and sanctioned the now historic phrase, "The Governor-General in Council applying to the Supreme Government in India.

Act, 1871' (Act xxxi. of 1871), and therefore neither the units defined in the Act, nor the multiples and submultiples thereof, have been brought into use."

"I may add, however, that as an exceptional case, the Government of India, in the year 1902, authorised the admission at Indian Custom-houses, under certain conditions, of the metric system of count, as an alternative to the British system, for the marking and description of woollen and silk yarns imported into British India."

AUTHOR'S NOTE.—*The idea of the Act was evidently to put the W. and M. throughout India on a uniform basis (see page 158) and the fact that successive Governors-General in Council have withheld it from notification in the* Gazette of India, *is probably because the benefit of the Act has been frustrated through the failure of the Imperial Parliament to adopt the Metric standards as the only legal standards in the United Kingdom.*

The following are a few notes upon the Act, in case it should at any time be notified in the *Gazette* :—

SECTION 1. The Act would extend to the whole of British India* (but Burma was not annexed in 1871).

SECTION 2 and 3. The primary standard of weight would be the "ser," and of capacity, a measure containing one such ser of water, and hence also called a ser.†

The "ser weight" is defined as equal to one "kilogram."
The "ser measure" would therefore be equal to one "liter."

SECTION 4. The gradations of these primary units would be decimal, unless otherwise notified in the *Gazette of India*.

---

* Legally speaking, the term "British India" does not include the States governed by native Princes who are merely under British suzerainty.

† Measures of capacity are unrecognised as such among the Indians, the measures which are employed for convenience' sake, being intended to represent some specific weight. This peculiarity clearly indicates that the Metric System, with its practical relation between the measures of length, area, volume, capacity, and weight, would appeal to the native mind far better than Imperial denominations do, and it is a step backwards for India to be slowly introducing the latter.

SECTION 17. Where native weights or measures of capacity values differing from the general value in India, the I Governments would be permitted to prepare a local tab equivalents with the Metric standards.

Act 2 of 1889.

"Measures of Length Act."

This Act was brought into force on 15th June, 1889 (see *Ga of India*, 1889, part 1, page 305) and by Act 13 of 1898, sectio extended to Upper Burma, except the Shan States.

SECTIONS 2 and 4. The primary unit is the Imperial standard y which is subdivided into Imperial feet and inches, and t are the only legal standard measures of length. (standard or true length at 85° Fahr.)

AUTHOR'S NOTE.—*Nothing is said about superficial or c measures.*

Act 18 of 1889.

"Central Province Municipalities."

SECTION 84. A committee (municipal committee) may from t to time at a special meeting make rules (after previous publ tion) consistent with this Act . . . *(d)* for prescribing standard* weights and measures to be used within Municipality.

Bengal.

Act 4 of 1866.

"Calcutta Police Act."

SECTION 55. The Commissioner of Police shall keep in his Offi standard* weights and measures; and weights and measu shall be held to be false when they do not agree with st standards.

* The Author is communicating with the Government of India, to ascertain these standards are based on Native denominations, or are copies of the ordin Imperial Standards, or include both. In the meantime, it seems that in addition certain ordinary Imperial standards, the Assay Masters of the Provinces have their keeping standards of the Tola (equal in weight to the Rupee coin) a decimal derivations of same, also of the Ser. The series adopted is 6, 3, 2 (see "Series," page 114).

Madras.

The sections below mentioned are of the same substance as the above-mentioned sec. 55 of the Calcutta Police Act, the false weights and measures being destroyed.

Act 1 of 1884.

"Madras City Municipal Act."
Section 354 *(b)*.

Act 3 of 1888.

"Madras City Police Act."
Section 32.

Bombay.

Regulation 12 of 1827.

SECTION 20. (In force in the whole Bombay Presidency, except the Scheduled Districts: also in force in Sindh.) The District Magistrate shall keep standards* of such weights and measures as are used in retail dealings throughout the districts under his charge, and they shall be open to the inspection of any one who may desire to examine them.

Act 3 of 1888.

SECTION 418 *(1)*. The Commissioner (the Municipal Commissioner for the City of Bombay) shall from time to time provide such local standards* of weights and measures as he deems requisite for the purpose of verification of weights and measures in use in the city, and shall make such arrangement as he shall think fit for the safe keeping of the said standards.

Coinage and Paper Currency Acts of India.

Also see Indian Money, page 166.

Act 23 of 1870.

"India Coinage Act, 1870."

This is a consolidating Act, and is now printed as modified up to June 27, 1893.

* See note on previous page.

SECTION 12 is repealed by Act 22 of 1899 (see also Act 1899 as amended by Act 7 of 1900), which makes the Sovereign legal tender, concurrent with the Rupee, rate of 15 rupees to the sovereign.

SECTIONS 19 to 26 referred to Bullion, and are repealed by A 1893, which stopped the free coinage of silver.

Act — of 1882.

"India Paper Currency Act, 1882."

This is also a consolidating Act, and is also now print modified up to June 27, 1893.

The Act has been amended by Act 22 of 1899, which permi currency notes to be paid in gold as well as silver, at the r fifteen rupees to the sovereign.

SECTION 19 provides that the whole amount of the coin bullion received under this Act . . . for currency notes be retained and secured as a reserve to pay those notes the exception of such an amount not exceeding **100*** mi of rupees.

Act 8 of 1900.

"Paper Currency Act, 1900."

Provides for a gold reserve for the paper currency; the lir its duration has been repealed by Act 9 of 1902, so that it is a standing Act.

* Act 21 of 1896.

MEASURES OF EXTENSION.

LINEAL MEASURES.

Imperial Measures.

The METER* with its Decimal derivatives, by Act of 1897; and the following:—

(Primary Unit—the Yard. See Act of 1878, sections 10 and 11. The yard is about 10 per cent. less than the Meter.)

1 inch, *in.* or "
12 inches = 1 foot, *ft.* or '
3 feet = 1 YARD, *yd.*

Also for Land only.

22 yards = { 1 chain, *ch.* / of 100 links, *lk.*
1760 yards *or* 80 chains = 1 mile, *m.*

(*And the following "non-essential" Land measurements.*)

5½ yards = 1 pole, rod or perch, *p.*
40 poles = 1 furlong (or ⅛th mile) *fur.*

Notes.

The STANDARD INCH at the Board of Trade is "divided into 12 duodecimal, 10 decimal, and 16 binary equal parts." This subdivision is adopted by South Australia; in South Nigeria the diminutions are in eighths only; and so on. In fine work, unless the Metric System is used, manufacturers are driven to use unstatutory centesimal subdivisions, *i.e.*, there is no statutory standard to check these fine subdivisions by, except in Canada, where the inch is divided into tenths and hundredths by law.

Our system of denoting feet and inches with double and single ticks, or dashes, has often led to mistakes being made when fittings of engines, &c., have been ordered. Thus 15" might be mistaken for 1' 5", but 15 millimeters could not be mistaken for 17 millimeters.

THE CHAIN.—The division of the chain into 100 links, each of 7·92 inches, was authorised by Order in Council dated June 27, 1876.

* Or Metric-Yard, about 10 per cent. longer than the Imperial Yard, or 3 ft. 3⅜ inches (all threes). For other comparisons see page 138.

Approximately the chain is equal to 20 meters, and the link to decimeters.

ORDNANCE SURVEY MAPS.—The New Town Maps are plott to a scale exactly equal to 2 meters to the kilometer; whilst that the Parish Maps is exactly equal to 4 decimeters to the kilomet (see "The Ordnance Survey," page 144).

It is interesting to know that the old London or Roman mile w 1,000 paces; and that the old English mile was of 10 furlongs eac of 10 chains, and the chain was equal to 10 fathoms. In the fifteent century, the yard was approximately equal to the length of pendulum vibrating seconds of mean time, &c., namely, 39·1 present inches, *i.e.*, approximately 1 meter.

For "Our Muddled Measures of Length" see page 48, and th proposed "Railway Mile," page 148.

Metric Measure is used in the "system of count" in the Yar Trades.

Nautical Measures.

Nautical Measures, like the theoretical Metric measures, are derived from the subdivision of the Earth's circumference. They are not referred to in any Weights and Measures Act, excepting that the Fathom, although not a statutory standard, appears in a Metric table of comparisons, as 6 feet. For practical purposes the nautical fathom may be taken as this length, but let us see exactly what it is.

A circle is divided into 360 degrees, each of which is divided into 60 minutes, and and one of these minutes on the Earth's surface is either a nautical or a geographical mile, again divided into 1,000 parts called fathoms.

The nautical and geographical miles would be of equal length, if the Earth were a perfect sphere, but at the equator there is a belt of matter 13½ miles in thickness all round the Earth, called the Equatorial protuberance.

A nautical mile is defined as the length of a minute of arc of the meridian, *i.e.*, longitude.

A geographical mile is defined as the length of a minute of arc measured on the Earth's Equator (see page 215).

These miles are often called knots, but a knot is the unit of velocity used in navigation. Thus a "log" or float is thrown into the sea attached to a cord or log-line wound on a reel; the log remaining at rest, the cord is paid out as the ship travels, usually for a period of 30 seconds or 1-120th of an hour. To facilitate the measurement of the cord paid out, and thus ascertain the speed of travelling, the cord has "knots" in it, at 1-120th of a nautical mile apart (about 50·6 feet or 15·43 meters) so that the number of knots paid out in the 30 seconds is equal to the number of nautical miles per hour at which the ship is travelling. Most ships now carry a patent log.

Fathoms are used for depths; cable's lengths for ship's distances from one another, &c.

Approximately, 6 nautical or geographical miles are equal to 7 statute miles; also to about 11 kilometers.

If kilometers were used for estimating marine distances, instead of these miles, and the cord was similarly paid out for 30 seconds, the knots in it would be 1·120th kilometer or 8·3 meters apart. See French Angular or Circular measure, page 169.

TABLE.

6·077 (longitude) or 6·087 (latitude) feet* = 1 true nautical fathom, *fa.*

100 fathoms	=	1 cable's length
10 cables' lengths *or* 1,000 fathoms *or* 1·151 stat. m.	=	1 nautical mile *or* 1 minute of arc of longitude, commonly called a "knot."
60 nautical miles *or* 69·05 stat. m.	=	1 degree.
60 geographical miles *or* 69·17 stat. m.	=	1 degree of latitude at the Equator.
360 degrees	=	The Earth's circumference.

Cape Lineal "Land" Measures.

Unit, the Cape foot. Basis 1,000 Cape feet are equal to 1,033 Imperial feet (Act 9 of 1859, page 32).

1·033 *Imperial inches*	=	1 Cape inch.†
12 Cape inches	=	1 „ foot.
12 „ feet	=	1 „ rood (practically obsolete)

5111·326 Cape feet *or* 425·944 „ roods	=	1 Imperial mile.‡
1 hour's riding	=	about 6 miles.
12·396 Imperial inches	=	1 Cape foot.
1033 „ feet	=	1,000 „ feet.
And *approximately* 1000 „ „	=	968 „ „

* The Admiralty adopt a basis of the "mean" diameter of the Earth, and obtain 6.080 feet or 1·15 stat. m. = 1 Admiralty knot; undoubtedly this is the best, for ships do not travel always due North and South, or East and West along the Equator only.

† As the Cape Lineal Measures are only legal for land, and Surveyors divide the foot decimally, the Cape inch is only used (and that seldom) for plotting. See "Note" on page 49.

‡ Miles are not spoken of by the Dutch farmers.

The stands at Johannesburg and most Transvaal towns measured in Cape feet, being mostly 100 × 100 or 100 × Approximately 50 Cape feet = 51 ft. 8 in. (Imp.) *i.e.*, for every 50 C feet add on 20 inches to convert to Imperial measure. 50 Cape f are also approximately equal to 15·75 meters.

Quebec Lineal Measures. (For Certain Lands Only.)

(*See Sec.* 12, *chap.* 104, 1886, *page* 28).

12·79 *Imperial inches* = 1 French or "Paris" foot.
18 French feet = 1 French perch.
180 " " = 1 arpent.

For Metric equivalents, see page 47.

The French "toise" and "ell" (*aune*) are illegal.

Old Lineal Measures.

These are given here because, being taken mostly from parts the body, they are convenient for use when one finds one's se without a measure. The system is the basis of the Native measure in India and the old Biblical measures.

3	barley corns (in length)	=	1 inch.
$\frac{3}{4}$	inch	=	1 digit (finger's breadth).
$2\frac{1}{4}$	"	=	1 nail, *n.*
3	"	=	1 palm.
4	"	=	1 hand *hd.*
9	" *or* 4 nails	=	1 quarter yard (*qr.*) or span.
18	"	=	1 cubit (fore arm).
5	quarters	=	1 English ell (ulna or whole arm).
8	" *or* 6 feet	=	1 fathom (from extremities of the two arms extended).
$2\frac{1}{2}$	feet *or* 30 in.	=	1 military pace.
5	"	=	1 geometrical pace (2 steps).

The nail, quarter and ell survived for some time in *Cloth Measure*; the hand is still used in measuring horses; the pace of 30 inches in Military drill; and the fathom in measuring depths of oceans, and formerly mines, wells, &c.

SURFACE, SUPERFICIAL, OR SQUARE (Sq.) MEASURES.

Imperial Measures.

The SQUARE METER * and its Centesimal derivatives by Act of 1897; and the following irregular subdivisions and multiples of the Imperial standard yard (Act of 1878, sec. 12):

	= 1	square inch, *sq. in.*
144 square inches	= 1	,, foot, *sq. ft.*†
9 ,, feet	= 1	SQUARE YARD, *sq. yd.*

Also, for Land only.

484 square yards *or* 10,000 ,, links	= 1	square chain, *sq. ch.*
10 ,, chains	= 1	acre, *a.*
6400 ,, chains *or* 640 acres	= 1	square mile, *sq. m.*

And the following "non-essential" Land measurements:

30¼ square yards	= 1	square pole, rod or perch, *sq. p.*
40 ,, poles	= 1	rood or ¼ acre, *r.*

NOTES.

There are no lineal roods or acres; an acre has four equal sides of about 208 feet; 10 acres = 1 square furlong; but the latter term is not used. Superficial Measure (in the ordinary system) is therefore imperfectly related to Lineal Measures, for in a perfect system "all" the Superficial denominations should be derived by squaring the Lineal Measures.

Unfortunately, Section 12 of the 1878 Act defines the acre as of so many roods and square poles, although it is measured by the Chain.

---

* Or Square Metric-yard. For comparisons see page 139.

† Glass is bought and sold by the foot super, according to thickness. Marble, stone, &c., are sold by the foot lineal, superficial and cubic.

Table-books, and Auctioneers in their Sale Particulars, are respo sible for propagating these subdivisions of the acre (obsolete exc on paper), it being easier and more accurate to keep parts of acre in decimal fractions, as surveyed and given on the Ordnan Survey Maps. Three or four places of decimals are ample f ordinary purposes.

EXAMPLE :—A rectangular piece of land measures 6 chains links by 4 chains 5 links = 6·28 × 4·05 = 25·4340 sq. chains or 2·54 acres. This may be given for ordinary purposes, and the decim point avoided, thus 2a. 543.

THE SCOTCH ACRE is not statutory, but survives in places ; it 6150·4 sq. yards, or roughly one-half of the hektar of 10,000 sq meters; it was divided decimally into 10 square chains and 100,00 sq. links. The Irish and Welsh acres are obsolete ; they were no far short of the hektar in area.

For adoption of Metric Land Areas and the proposed "Plough man's Acre," see page 134.

Cape Square Land Measures.

(*See Act 9 of 1859, page 32.*)

1 Cape square foot.*
144 Cape square feet = 1 „ „ rood.
600 „ „ roods = 1 Morgen
1 morgen = 2·11654 Imperial acres or approximately 1 hektar.
302·38 morgen = 1 Imperial square mile.

An Erf (plural *erven*) is a plot of land, varying in size in different localities : the term, equally with that of stand, does not denote a "measure" of land, although one often hears of a piece of ground being spoken of as "of so many erven in extent."

* As the Cape square measures are only legal for land, the Cape square inch is not used, Surveyors dividing the square foot decimally.

Useful Numbers for Converting Cape into International or Metric Land Measures, and the Converse.

For converting	Into	Multiply by	Converse.
Cape Lineal Feet	Lineal Meters	·31486	3·17603
" " Roods	" "	3·77832	·26467
" Square Feet	Square " or Centiars	·099136	10·08716
" " Roods	" " "	14·27555	·07005
" Morgen	" " "	8565·3298	·000116 75
" "	Hektars	·8565	1·1675

For Indian Measures, see page 160.

CUBIC or SOLID MEASURES; or MEASURES OF VOLUME.

Imperial Measures.

The CUBIC METER,* with its millesimal derivatives, by Act, 1897; and the following subdivisions of the Cubic Yard :—

	1 cubic inch, *cu. in.*
1728 cubic inches	= 1 cubic foot, *cu. ft.*†
27 cubic feet	= 1 CUBIC YARD, *cu. yd.*

In the Metric System, 1 cubic meter of water weighs 1 Metric Ton, and is equal to 1 Kiloliter. Therefore, if the Specific Gravity of a substance is known, it can be measured up to find its weight, or *vice versâ*. The want of such design in the Imperial jumble has caused a confusion of thought regarding :—

The Ton Weight as a Measure of Volume.

SHIPPING TONS :—

34·4 cu. ft. Salt Water‡		= 1 Metric Ton, or 2,204⅝ avoir. lbs.
34·9 „ „ „		= 1 Ordinary Ton, or 2,240 „ „
35·3 „ or 1 cu. meter	Fresh Water	= 1 Metric Ton, or 1,000 kilogs.
35·9 cu. ft.	„ „	= 1 Ordinary Ton, or 1,016 „

A British "Ton of Displacement" is taken as 35 cu. ft., which is approximately equal to 1 cu. meter. The Displacement Tonnage System furnishes the fairest means of comparison between different types of warships, and is adopted by the British Navy. If the system were also used for the Register Tonnage of our Merchant Navy, there would be no great difficulty regarding Shipping Tons, but a "Register Ton" is at present taken as 100 cu. ft., and so highly important and complicated is this part of our subject that it is specially dealt with on pages 53 to 59.

---

* Or Cubic Metric yards (for comparisons see p. 140).

† Gas is measured by the cubic foot (see "Gas," page 189).

‡ At the Thames Court, Dec. 28, 1903, a Ship's Master was fined £10 and £21 costs for exceeding his load-line. His defence was that he loaded up in Salt Water in a Tidal River, thinking it was Fresh Water.

MERCHANDISE AND TIMBER (generally speaking) are lig
than water, that is to say, 1 ton of merchandise or timber ta
up more room than 1 ton of water; hence, a "shipping ton
merchandise" is often roughly computed at 40 cu. ft., and
"shipping ton of timber" at 42 cu. ft.

TONS OF EARTH, Gravel, and similar substances :—Suchl
materials are heavier than water,* and therefore a ton in the
cases takes up less space.

A ton weight is about a one-horse load; hence "*a load of Earth*
(in England†) *generally means 27 cu. ft., or 1 cu. yd.*

TIMBER AND WOOD :—

On an average, a ton of wood occupies about half as much spa
again as a ton of water; hence, "a ton (or load in England†)
squared or hewn timber" is often taken at 50 cu. ft., but, of cours
it varies with the kind of wood, some kinds being heavier tha
others.

In England a "load" (not ton) of unhewn timber has often n
reference to its weight, being generally reckoned at 40 cu. ft. only
because it is often of awkward shape for cartage.

A "ton" and a "load" of timber are therefore regulated by
custom, the kind of wood, and whether it is in the rough state,
squared, or cut up. The definition of a "ton of timber" also varies
in different Canal Acts.

These puzzling differences will continue until an Act of Parlia-
ment defines a timber ton as of so much weight, as is urged of
consignors by Railway Companies. They show the want of a
system of weights and measures in which there is a direct relation
between measures of volume and weight.

To find the Volume or Contents of Round or Unhewn timber :—
Take the average girt in inches, divide by 4, deduct 1 or 2 inches
for bark, square the result, which gives the mean sectional area.

---

* See "Specific Gravities," p. 18[illegible].

† See "Loads," p. 61.

CUBIC or SOLID MEASURES; or MEASURES OF VOLUME.

Imperial Measures.

The CUBIC METER,* with its millesimal derivatives, by Act, 1897; and the following subdivisions of the Cubic Yard :—

	1 cubic inch, *cu. in.*
1728 cubic inches	= 1 cubic foot, *cu. ft.*†
27 cubic feet	= 1 CUBIC YARD, *cu. yd.*

In the Metric System, 1 cubic meter of water weighs 1 Metric Ton, and is equal to 1 Kiloliter. Therefore, if the Specific Gravity of a substance is known, it can be measured up to find its weight, or *vice versâ*. The want of such design in the Imperial jumble has caused a confusion of thought regarding :—

The Ton Weight as a Measure of Volume.

SHIPPING TONS :—

34·4 cu. ft. Salt Water‡		= 1 Metric Ton, or 2,204½ avoir. lbs.
34·9 " " "		= 1 Ordinary Ton, or 2,240 " "
35·3 " or 1 cu. meter	Fresh Water	= 1 Metric Ton, or 1,000 kilogs.
35·9 cu. ft.	" "	= 1 Ordinary Ton, or 1,016 "

A British "Ton of Displacement" is taken as 35 cu. ft., which is approximately equal to 1 cu. meter. The Displacement Tonnage System furnishes the fairest means of comparison between different types of warships, and is adopted by the British Navy. If the system were also used for the Register Tonnage of our Merchant Navy, there would be no great difficulty regarding Shipping Tons, but a "Register Ton" is at present taken as 100 cu. ft., and so highly important and complicated is this part of our subject that it is specially dealt with on pages 53 to 59.

---

* Or Cubic Metric yards (for comparisons see p. 140).

† Gas is measured by the cubic foot (see "Gas," page 189).

‡ At the Thames Court, Dec. 28, 1903, a Ship's Master was fined £10 and £21 costs for exceeding his load-line. His defence was that he loaded up in Salt Water in a Tidal River, thinking it was Fresh Water.

MERCHANDISE AND TIMBER (generally speaking) are lig than water, that is to say, 1 ton of merchandise or timber t up more room than 1 ton of water; hence, a "shipping ton merchandise" is often roughly computed at 40 cu. ft., an "shipping ton of timber" at 42 cu. ft.

TONS OF EARTH, Gravel, and similar substances:—Such materials are heavier than water,* and therefore a ton in th cases takes up less space.

A ton weight is about a one-horse load; hence "*a load of Eart* (in England†) *generally means 27 cu. ft., or 1 cu. yd.*

TIMBER AND WOOD:—

On an average, a ton of wood occupies about half as much spa again as a ton of water; hence, "a ton (or load in England†) squared or hewn timber" is often taken at 50 cu. ft., but, of cours it varies with the kind of wood, some kinds being heavier tha others.

In England a "load" (not ton) of unhewn timber has often n reference to its weight, being generally reckoned at 40 cu. ft. only because it is often of awkward shape for cartage.

A "ton" and a "load" of timber are therefore regulated by custom, the kind of wood, and whether it is in the rough state squared, or cut up. The definition of a "ton of timber" also varies in different Canal Acts.

These puzzling differences will continue until an Act of Parliament defines a timber ton as of so much weight, as is urged of consignors by Railway Companies. They show the want of a system of weights and measures in which there is a direct relation between measures of volume and weight.

To find the Volume or Contents of Round or Unhewn timber:— Take the average girt in inches, divide by 4, deduct 1 or 2 inches for bark, square the result, which gives the mean sectional area.

---

* See "Specific Gravities," p. 183. † See "Loads," p. 61.

Multiply this by the length of tree and divide by 144 ; the quotient = contents in cu. ft.

$$\text{Formula for above :—} \frac{(\frac{1}{4}\ \text{girt})^2 \times \text{length.}}{144}$$

For calculating quantities in timber as above, use Hopus's or some other Timber Tables.

If the timber is exactly a circular cylinder, not tapering at all, use this formula :— $\frac{(\frac{1}{5}\ \text{girt})^2 \times \text{length} \times 2.}{144}$

NOTE :—Here again it must be noted that there are half a dozen different customs of applying these formulæ ; it makes a considerable difference, for example, whether the girthing tape is folded or not to arrive at the quarter-girt (see Mr. Stewart Wallace's evidence in the Report of the Select Committee of the House of Commons on Weights and Measures, 1895).

Names of Sawn Deal Timber.

Slate battens,	about	$\frac{3}{4}$	in. thick	by	2	in. wide.		
Boards,	about	$\frac{1}{2}$	in. to $1\frac{1}{2}$	in. thick	and	9	in. to 11	in. wide.
Scantling,	„	2	in.	„	by	4	in. „ $4\frac{1}{2}$	in. „
Deals,	„	3	in.	„	„	7	in. „ 9	in. „
Battens,	„	2	in. to $2\frac{3}{4}$	in. „	„	6	in. „ 8	in. „
Planks,	„	$1\frac{1}{2}$	in. „ $4\frac{1}{2}$	in. „	„	11	in. and upwards.	
Baulks,	„	5	in. by 5	in. and upwards.				

NOTE.—The fact that there are variations in the above examples of sizes, demonstrates that the adoption of the Metric System will in no way interfere with the present dimensions to which Timber is cut. In fact, a large percentage of imported Timber, coming as it does from metric-using countries, is in reality cut up in metric measurements. Thus, what we call 2 in. by 4 in., is, in decimeters $\frac{1}{2}$ by 1, and the International decimal system, is incomparably easier for Quantity Surveyors and others, than the present mode.

THE "UNIT OF ROOMAGE" FOR SHIPPING

COMMONLY CALLED

REGISTER TONNAGE.

100 cubic feet or
2·83 „ meters } make 1 Register Ton of Shipping.

Importance of a Unit.—The Tonnage inscribed on the c
cate of registry of a British ship constitutes the measure o
contribution to Harbour and Dock charges and the smaller
dues, in British and certain Foreign ports. If any change is
in the unit employed, its effect on those who pay dues and t
who receive them must be carefully studied.

The space ton is also the measure of the amount to which a
owner may become liable for any damage caused by his ship,
it has important mercantile uses in connection with the purch
sale, hire and chartering of ships. But in these respects any alt
tion in the assessment of the unit would right itself.

How it has varied.—Owing to the sides, floors and ceiling
ships being curved in all directions, it is somewhat difficult to ca
late the cubic contents of its different parts. Until 1836 the sys
prevailing had been the square of the breadth multiplied by
inboard length, the number of cubic feet thus obtained be
divided by 94.*

In the Merchant Shipping Act of 1835 the divisor for certa
purposes was 92·4. By the Act of 1854 the cubic contents w
ascertained by the formula known as "Sterling's Rule," bei
somewhat similar to the old-fashioned Simpson's rule for computi
areas, applied to cubic contents. That is to say, the length of t
ship is divided into a certain number of equal parts, according
its length; the transverse areas are then calculated, multiplied
4, 2 or 0, added together, and multiplied by one-third of the co
mon interval between them. The result is cubic contents, and th
divisors fixed by *Moorsom's system* are—100, if the measuremen

* The breadth and depth were assumed equal; in the United States the divis
used until 1865 was 95.

are taken in feet and decimal parts of the foot (duodecimal inches being useless in surveying), and 2·83 if taken in meters and its decimal derivatives.*

The Present Confusion.—The International Tonnage Commission assembled at Constantinople considered whether it would not be better to suppress the name of "ton of measurement," in order to avoid *the continual confusion* between this ton and the different tons of weight or volume employed in trade, but it formed the opinion that the time had not *yet* (1873) come when such a change could be recommended.

The Metric System.—From time to time since 1873 all the Maritime Powers, except the Anglo-Saxon, have adopted the Metric System and employed it in computing their tonnage, and unless Great Britain adopts the system before the next International Conference she will be handicapped by using a different commercial language to the other Powers. This is absolutely needless regarding shipping, considering that the gross tonnage, gross deductions and net tonnage of every ship now measured by the Board of Trade Surveyors must be converted into cubic meters (see pages 42 and 46 of Green Book), and there is no substantial reason why the Metric Measures should not at once be substituted for the *decimalised foot*. Once the Metric System is universally adopted, a proper International name for the space ton will probably be found.

Decimal Coinage.—On page 150 of this book it is shown that if the Florin is decimalised—in other words, if the penny is reduced 4 per cent. in value—that it need in no way interfere with the present earnings of the Docks, and decimal coinage would simplify the calculations of dock dues, &c.

But it might be thought preferable to reduce the factor of 2·83 cu. meters (100 cu. ft.), to 2·72 (96 cu. ft.), or to two and three-quarter cu. meters exactly.

* Moorsom's system has since been amended and elaborated in detail, the whole of the Merchant Shipping Acts being consolidated by the 1894 Act, in which Sections 6, 77 to 86 inclusive, and the second, third and sixth schedules relate to the measurement of ships and tonnages. These are included and explained with other information in "Instructions relating to the Measurement of Ships (1903)," issued by the Board of Trade (hereinafter referred to as the Green Book). Other Merchant Shipping Acts, have been passed since, and are also in force, namely, those of 1896, 1897, 1898, 1899, and 1900.

An Official Secret!—With the foregoing idea, inquiry therefore made at the Board of Trade Office (54, Victoria St., S whether 100 cu. ft. was merely decided upon in the past becau its decimal convenience to the British, and whether it had be too fixed to alter. The Principal Surveyor of Tonnage replied, ever, that the matter being one of great importance to Bi interests, he deemed the whole subject "an Official Secret."

But there are more ways than one of safe-guarding Bi interests, and the writer, feeling that they can best be protecte the British people know what they are, pursued the matter in official quarters, and found that—

A Royal Commission on Tonnage was held in 1881, and Report and Evidence were made "Public" in a large volun The Report, together with reasons why three of the Commissior did not sign it, can be purchased separately of His Majes stationers, price 6d. It shows that a wide divergence of vie existed on tonnage in 1881.

Gross and Net Tonnage.—The present system of measu ment is no doubt a good one for ascertaining the contents in cu feet or meters, but since the introduction of coal-consuming vesse large deductions from the Tonnage, in their favour, have be allowed. These deductions are arrived at in a peculiar mann Thus we find there is the *actual* engine-room and the *theoretic* engine-room (see pages 27 and 28 of Green Book). The result one case was that the deductions for engine-room, propellin power, &c., gave a steam tug a net or register tonnage of minu 4·64 tons (87·72—92·36). We also find that there is often a gre disproportion between the register or supposed freight-earnin tonnage and the carrying capacity of steamers: also that a ship ca go out of port one day with a certain tonnage, and return shortl afterwards with the tonnage greatly reduced without any alteration in the external form or build of the ship.

Other deductions *of reasonable extent* are allowed to be made although we are told that Mr. Moorsom, the author of the presen system of admeasurement, was strongly opposed to all exemptions saying that no tonnage law could, in his opinion, be satisfactory, so long as any exemptions were allowed.

* Vol. xlix., Reports Commissioners, C, 3074, 1881, British Museum.

Well-deck Ships.—The present regulations encourage this build of boat, which the Commissioners of 1881 concluded was adapted for the safe conveyance of "cargo." The result is that third-class passengers on many lines are deprived of any smoke-room, any proper promenade deck on a three-week voyage, and shelter from the elements unless they go down below. The well-deck boats were used largely as Transports for men coming from the Tropics into cold foggy weather. All this, because a few tons' weight of materials would enclose many space tons subject to dock dues.

Present International "Disagreement."—Pages 37 and 38 of the Green Book give a list of countries which have adopted Moorsom's system of admeasurement and unit of roomage, and the ships of which are no longer required to be remeasured in any port or place in His Majesty's dominions.

Nevertheless, the deductions for crew-space, engine-room, &c., allowed by these 16 countries and Great Britain, so vary, that if one ship from each country were taken, of the same build and carrying capacity, there would probably be a dozen different net or register tonnages.

It would appear, therefore, that the deductions allowed British ships for crew-space, &c., in British ports are not allowed them in Foreign ports, whereas Foreign ships in British ports are allowed British Tonnage Certificates (p. 36 of Green Book), the charge for remeasuring being only 10s.

The instructions on p. 47 of the Green Book show that when a shipowner wishes a ship to be remeasured for a Special Certificate under the rules applicable to the Suez Canal, application is to be made on a special form. And again on page 48, § 7 we find that owners can elect not to use the "Danube Rule" relating to movable coal bunkers.

If tonnage dues are to be studied, the various regulations now in force, also necessitate two different builds of ship for journeys to the Cape and back by the West Coast and voyages completing the circuit of Africa.

Another want of uniformity is shown when ships are lost to the British Flag; their registry tonnages are increased in the country they go to.

The Load Line.—Mr. Chamberlain speaking at Liverpool Oct. 27, 1903, is reported to have said :—

> Look at the disabilities to which British ships are exposed. We put up them all sorts of regulations—right regulations, mind you—I am myself author of some of the strongest of them. We require a load-line from the We require other precautions. Why? For the health and safety of the who go down to the sea in ships. While I say that is right, what do we with the Foreigner? We don't require any load-line from him. It possible, I am told, for an English ship in your port here of Liverpool to lo up to, say, 3,500 tons, and then to have an Inspector come on board and s "This won't do. This is above your mark, you must pull out 500 tons at once And then that steamer goes away with 3,000 tons of cargo. The next day, I a told, a foreign ship may come in, not marked at all, and may load up its 3,5 tons, and the 500 tons may make all the difference between profit and loss, a we allow him to have every one of the privileges which we give to the oth ships. These things want discussion.

A Shipping Resolution.—The day following the above mentioned speech, the *Liverpool Steamship Owners' Associatio* passed a resolution expressing the opinion that—

> In view of the changed condition in the maritime affairs of the world, owin to bounties, subsidies, and the operation of the navigation laws of foreig nations, the time had arrived for reconsideration of the laws and condition affecting the shipping of this country.

Unscientific Methods.—The aggregate British Tonnage * therefore by no means represents the carrying capacity of our Mercantile Marine, or their tons of displacement. It affords no true comparison with the register of other nations, or with Battleships. In short, it is difficult to see any scientific principle at all in the present system, and statistics, without lengthy explanations, are only understandable by those who compile them.

What is Wanted.—There is no valid reason why, on the ground of International arrangements, our tonnage law should not be altered. As things stand at present, if Great Britain to-day adopts a Metric unit, easy of application to the Suez Canal and the coming Panama Canal, not interfering with the external or internal build of ships, sound and just in principle, and giving fixity of charges, other nations will follow her example to-morrow.

* See page 223.

Our Merchant Navy should be able to "go anywhere and do anything!" with summer or winter cargoes, animate or inanimate cargoes, and so on, without structural alterations being required for the special purpose of keeping down tonnage dues. Thus beyond the refitting necessary to make a Passenger-cargo boat into a Transport, in time of emergency, no other structural alterations should be required on account of dock dues, whether the boat is taken off long voyages and put on short trips, or *vice versâ*.

Speaking generally, shipowners charge by weight and not by bulk or value, and the ships are built with this aim. The fairest system of measurement, therefore, appears to be the number of cubic meters between her line of displacement devoid of cargo * and her maximum load-line. Such measurement would give the maximum number of tons of displacement of her cargo, for 1 cubic meter of water is equivalent to 1 metric ton weight (see 'displacement tons' page 50) ; and the number of cubic meters or metric tons could be divided by a certain "convenient" factor to obtain a Register not exceeding the present Register.

Special Cases.—Reduced dock rates could be levied for ships carrying passengers only (*i.e.*, which might never reach the maximum load-line), and entering docks often, and the annoying dock dues on luggage could be abolished.

Sailing ships requiring a heavier load, *pro rata*, of food supplies, could also pay special tolls.

Foreign ships, which could not be measured devoid of cargo, bearing no maximum load-line, and perhaps bounty-fed, would be charged at heavier rates on the present unit, until matters are regulated at the next International Conference. But of course due notice would be given some time before the change was made, so as to enable Foreign ships to adopt a load-line.

Conclusion.—It has been shown that the Metric system and Decimal Coinage can be adopted without interfering with either the present unit of roomage or with dock dues.

* Perhaps the ship should be devoid of coal also, for it must be remembered that ships taking long journeys pay dock dues less often. On the other hand, the cheapening of passenger fares for long trips to distant parts of the Empire is worth considering.

On the other hand, their adoption will facilitate and afford opportunity of adjusting register tonnage, the navigation laws a dock dues, as needs be.

No more perfect system could be found from which to deri the unit of roomage, or ship's burden, or whatever in future it m be called, because—

1 cubic meter of water
1 metric ton weight ,,
1 kiloliter ,,
} are the same quantity.

It is evident that until Great Britain makes radical changes in thes respects, there will be no "sound" International Shipping Agree ment.

MEASURES OF CAPACITY

OR

LIQUID AND DRY MEASURES.

(Theoretically these should come after Avoir. Weight, from which the gallon is derived. To do this, however, prevents the following on of Troy, Bullion, and Coin Weights, in turn succeeded by "Money.")

Imperial Measures.*

The LITER † with its Decimal derivatives, by Act of 1897, and the following :—

* Act 1878.

SEC. 17. "In using an imperial measure of capacity, the same shall not be heaped, but either shall be stricken with a round stick or roller . . . or if the article sold cannot from its size or shape be conveniently stricken shall be filled in all parts as nearly to the level of the brim as the size and shape of the article will admit."

SEC. 19. "No local or customary measures, nor the use of the heaped measure shall be lawful."

† Or *Metric Quart*. The *Metric bi-gallon* or "double-gallon" would be 1 dekaliter. For comparisons, see page 143.

(PRIMARY UNIT :—The Gallon, containing 10 Imperial standard pounds weight of water * at 62° Fahr. See Act, 1878, Sec. 15. 2 gals. are about **10 per cent.** less than the Dekaliter.)

		1 pint, *pt.*	
2 pints	=	1 quart, *qt.*	
4 quarts	=	1 GALLON, *gal.*	
2 gallons	=	1 peck, *pk.*	
4 pecks	=	1 bushel, *bush.*	Fast becoming obsolete as Trade measures.
8 bushels	=	1 quarter, *qr.*	
36 „	=	1 chaldron, *chal.*†	

The Gill, Quartern, or Noggin, is not mentioned with the other denominations in Sec. 15 of the 1878 Act, but it is given in the Second Schedule, without being defined. The same omissions occur in many of the Colonial Acts. It varies locally, but in Australia, and, usually, it is taken as $\frac{1}{4}$ pint (say 1 deciliter). It is not used throughout South Africa, but is in West Africa. In the North of England it is $\frac{1}{2}$ pint.

Liquid Measure, commonly so called, includes only the Pint, Quart, and Gallon measures, and in some parts the Gill. The measures are made of metal. Casks are not Imperial measures (see page 65).

Dry Measure, commonly so called, includes all the measures named in the Act, but not the Gill. The measures are made of wood, and tested with rape seed, which should be shot into the measure by a "hopper" 6 inches above the measure. Most dry goods, however, are now exchanged by Avoir. Weight, counted, or "by price" (*e.g.*, sixpenny-worth of nuts).

The Bushel. No two men can measure a sack of grain alike. If the grain falls 2 or 3 feet into the measure and is then shaken, it contains over 10 per cent. greater weight of grain than if the grain

* As 8 pints make one gallon, the following may assist the memory :—

"A pint of pure water
Weighs a pound and a quarter."

No rhymes are required in learning the Metric System.

† For coke, the chaldron is divided into 12 sacks of 3 bushels each.

is merely gently placed in the measure. The Bushel is, therefor practically now only used as what may be called a qualitati measure for quoting prices, as distinct from a quantitative measu (see Corn Returns Act, 1882, p. 24, Corn, p. 73, and Tithes, p. 150 The Bushel could, therefore, be abolished, weighing being not onl more exact but quicker, and more general since the introduction Railways.

The Imperial bushel is 2219·7 c. inches, and the South Africa bushel is 2218·2 c. inches. The former was originally divided int 10 gallons.

The Quarter and **Chaldron** are also being displaced by Avoir Weight, the latter being first abolished as a measure for coal, i London in 1831.

Heaped Measure is apparently still legal in South Africa, New foundland, and British Guiana, the Weights and Measures Act i these cases being founded on Imperial Acts which are now repealed.

Local nicknames:—

2 bushels	=	1 strike, *str.*
4 „	=	1 coomb, *cb.*, or sack, *sk.*
5 quarters	=	1 weigh or load, *ld.*
10 quarters, 12 barrels of meal, about 2 tons of wool, or 13,200 fish	=	1 last (?) *(but not least!)*

Thus the strike and coomb, as such, are illegal denominations, but as measures of 2 and 4 bushels they are not illegal.

Loads must necessarily differ with the commodity, custom of the country, beasts of burden, and their number, condition of the roads, season of the year, &c., and it is absurd to say definitely in a book of school tables (especially in the Colonies) that it is 5 quarters, or 19 cwts. 32 lbs., &c., or 50 c. ft. of timber. An ox-team load in South Africa, for example, is about 5,000 lbs., or 50 short cwts.

There are also barge-loads, truck-loads, &c.

(*Also see pages* 51, 72 *and* 73.)

Cape Measures (illegal).

3 bushels (equal to 4 old schepels) = 1 muid or sack.

By Act 11 of 1858 (Cape Colony), the schepel and muid are declared illegal measures, but inasmuch as the muid is a multiple of

the standard bushel it is often still used, and in some parts it is fixed as a sack of 200 lbs. The sale in these cases is only *nominally* by the muid, but *actually* by the measure of 3 bushels, or weight of 200 lbs., both multiples of authorised units. It may be noted that in the British old heaped dry measure 3 bushels were also equal to 1 sack.

Three bushels = 109 liters ; the old muid was about $2\frac{3}{4}$ bushels or 100 liters, and Mr. D. E. Hutchins, F.R.M.S., in the Agricultural Journal of the Cape of Good Hope, suggests a "Metric-muid."

Fish Measure.

Before discussing the measure peculiar to the Scotch Fisheries, let us first see the necessity of authorising the same.

Big catches of fish must be landed and dispatched to their destinations as quickly as possible, owing to their perishable nature. To weigh the fish or measure it in the ordinary way, would not only take too long, but would be altogether unnecessary, because if a difference of two or three fish were made between two baskets, their value would be altogether infinitesimal, and the probabilities are that any small shortage in one basket would be made up in another. Moreover, the ordinary wooden measures of capacity are altogether unsuitable for allowing the water and slime to drain off when filling.

The Scotch Fishermen, therefore, used baskets known as quarter-crans. But in reality they were used as "measures," and not merely as "containing vessels" (compare "milk churns" and "cask measures" on following pages), and from their mode of construction could not be placed on the same footing as measures which were multiples of authorised units.

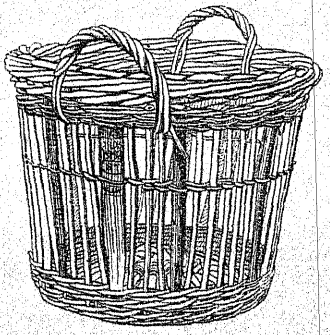
The Herring Fishery (Scotland) Act, 1889, by section 4, therefore authorised the cran and quarter-cran measures, when duly branded, as the only legal measures of capacity in the herring fishery of Scotland, but also permitted the sale of herrings "by weight, or number, or in bulk."

The capacity of the cran had previously been fixed in a Notice issued by the Fishery Board for Scotland, dated May 15, 1852, at Edinburgh, as being equal to $37\frac{1}{2}$ Imperial gallons.

The stamped wooden cran measure has always been reckoned the standard measure when any dispute arose between seller and

buyer, but as it is too unhandy for fishermen to use, the quarte
cran basket measure is really the only measure now used in th
herring fishery.

Regulations have been issued since the passing of the 1889 Ac
minutely describing the construction of the quarter-cran, and th
internal measurements. If the contents of a basket with larg
intervening spaces between the uprights of the sides can be give
in gallons, it may be said the quarter-cran contains 9⅜ gallons, equ
to 42·618 liters.



The Quarter-Cran, showing the raised centre, the branded piece of hardwood beneath each cane handle, 1½ inches broad, &c.; pieces of hoopwood (6 in number), 1 inch broad, bark outermost and equi-distant with willows in between; also the binding, waling and cane fitching, according to precise instructions issued by the Fishery Board of Scotland, the Quarter-Cran being the only "legal" local measure in use in the United Kingdom.

When the Metric system is made compulsory for all purposes, we may therefore consider the quarter-cran to be a measure of 42½ liters or cubic decimeters * the special mode of its structure being

* The average weight of a quarter-cran of fresh herrings would approximate to 42½ kilograms, showing the simplicity of the Metric system.

left to the Fishery Board for Scotland. That is to say, the present baskets would not be rendered useless, the "theoretical" difference between 9⅜ gallons and 42½ liters being only $\frac{1}{2\frac{1}{2}5}$th.

Apparently the quarter-cran is being adopted in parts of England, and the above detailed information is given to show that the quarter-cran could be used as a legal metric measure (of capacity or volume) in the Fisheries throughout the Empire.

A basket of an even 40 liters might be preferred in some districts.

The Author tenders his thanks to the Secretary of the Fishery Board of Scotland for supplying him with certain particulars. Also to Messrs. Anderson and Williamson, Basket Makers, Leith.

Milk.

If milk is measured into a churn, the churn is merely a "containing vessel,"* but if a churn used in trade is filled without first measuring, the churn becomes a measure in itself and must be stamped and verified. This is done on the inside by a metal slip.

Churns daily travelling by rail often become so indented that some of the large London milk contractors insist on buying by "weight," which to a slight extent takes into consideration the quality of the milk.†

Most churns are made to contain 17 Imperial gallons or about 77 liters. Of those going to London from Essex, for example, many are solely marked in what are called Barn gallons of 17 pints each, instead of 8 pints. Only 8 Barn gallons therefore go in a churn of 17 Imperial gallons, which is a great hardship to the farmer. No contract made in Barn gallons can be enforced, and Railway Companies will not recognise the measure. The introduction of Liters would do away with this illegal practice.

Casks.

Beer is sometimes sold by weight, but not often enough to be considered here.

* See Act 1878, sec. 22. This section evidently contemplated such matters as churns and casks; also sales such as a "bottle of beer," "a glass of milk," "a cup of tea," &c.

† Unfortunately, no Milk Act seems to exist allowing a special maximum variation for milk churns.

Casks, like milk churns, when filled by stamped measures, a merely receptacles or containing vessels, but if filled witho measure, which is usually the case, are measures in themselves.

Casks, however, present difficulties which milk churns do nc inasmuch as they shrink in the course of being used, and damage casks when re-coopered are often decreased slightly in size, to sav great waste of material.

Wine casks, coming as they do from several parts of the Worlc vary considerably.

By Parliamentary Paper, "Brewers' Casks" (329 of 1899) the verifying and stamping of casks appears impracticable. Lette No. 10 in this Report illustrates that the Merchandise Marks Act 1887, hardly meets the case adequately from the point of view o the purchasers, who seem to have suffered in some districts.

The Author suggests that the difficulty would be met by a special clause in an Act omitting Beer casks from stamping, but enacting that verified (Metric) standards of each size of cask used in a Brewery should be kept at each Brewery, and if a cask filled for sale is found to contain a specified quantity less than full measure, various penalties should be fixed for first and subsequent offences.

For "Best sizes of casks" see page 67.

To convert gallons to dekals, deduct 10 per cent and divide by 2. One dekal of water weighs 10 kilograms.

British Stout and Ale Casks.—In nominal gals. and dekals, the basis being 4½ gals., or 2 dekals, and the approximate weight with casks one quarter as much again.

4½	gallons		=	1 pin	=	2 dekaliters
9	"	= 2 pins	=	1 firkin, *fir.*	=	4 "
18	"	= 2 fir.	=	1 kilderkin, *kild.*	=	8 "
27	"	= 3 fir.	=	1 half hogshead, ½ *hhd.*	=	12 "
36	"	= 2 kild.	=	1 barrel, *bar.*	=	16 "
54	"	= 6 fir.	=	1 hogshead, *hhd.*	=	24 "
72	"	= 2 bar.	=	1 puncheon, *pun.*	=	32 "
108		= 2 hhd.	=	1 butt, *butt*	=	48 "

Usual Wine Casks in England : in nominal gals. and dekals.

10 gallons	=	1 anker	=	say $4\frac{1}{2}$ dekals.
18 „	=	1 runlet, *rum.* 1 beer kilderkin	=	„ 8 „
„	=	1 quarter cask, *qr. ck.* or aum of Rhenish wine	=	„ 14 „
42 „	=	1 tierce	=	„ 19 „

The wine puncheon of about 2 tierce is practically obsolete.

CASKS FROM ABROAD differ according to the country from which they come, and hence generally with the kind of wine they contain. But always—

2 hogsheads, *hhd.*, make 1 pipe or butt
2 pipes or butts „ 1 tun or about 1 ton-weight of wine.

1 hogshead of claret	=	about	46 gals.,	say 20 dekals.
1 pipe of Madeira or Cape Pontac	=	„	92 „	„ 41 „
1 „ „ Marsala	=	„	93 „	„ 42 „
1 „ „ Teneriffe	=	„	100 „	„ 45 „
1 „ „ Port	=	„	115 „	„ 52 „
1 „ „ Lisbon, Bucellas, &c.	=	„	117 „	„ 53 „
1 butt of Sherry and Tent	=	„	108 „	„ 49 „

To find the number of BOTTLES, or "nominal" or "reputed" quarts in a cask, divide the number of gals. by 2 and deduct 1 : the answer is in Dozens (but 1 doz. must usually be allowed). Or, as a nominal quart is exactly equal to three-quarters French liter, multiply dekals by 10, and add one-third : the answer is in Bottles (but a score must usually be allowed), which under the decimal system is more convenient than in dozens.

In South Africa, the stout and ale casks are the 9, 18, 27, 36 and 54-gal. casks (for metric equivalents see page 65), and they are so called, the names of firkin, kilderkin, &c., being obsolete. Not less than 5 gals. may be sold wholesale.

For spirits there are :—

2-gal. keg, say 9 liters.
4-gal. „ „ 18 „
5-gal. „ „ $22\frac{1}{2}$ „

The Wine Casks formerly used for the old Dutch measures are not all worn out, in fact, some are even still made, although their contents are usually spoken of in Imperial gallons, the basis being "equal to" $7\frac{7}{8}$. But the contents could more readily be marked on the casks in dekaliters, the basis being $3\frac{1}{2}$ dekals.

1 anker	= $7\frac{7}{8}$ gals., now used for	$7\frac{1}{2}$ gals.,	say $3\frac{1}{2}$ dekals.
1 half-aum	= 2 ankers „ „ „	15 „	„ 7 „
1 quarter cask aum, barrel, or $\frac{1}{2}$ hhd.	= 4 „ „ „ „	30 or so	„ 14 „
1 hogshead	= 8 „ „ „ „	63 to 72*	say 28 „
1 leaguer = 1 British pipe	= 4 aums „ „ „	127 gals.†	„ 56 „

In Canada, the capacity of casks containing liquids subject to excise must be legibly marked on the casks before delivery to the purchaser, "in gallons and parts of a gallon."

Ceylon is apparently the only country in which the contents of casks of certain names are fixed by an old Act, namely the hogshead at 63 gals., pipe at 126 gals., and the tun, holding over a ton-weight of wine, at 252 gals.

The Best Sizes for the future :—

The kilol (or kiloliter)	= 100 dekals,	say 1 tun.
„ half-kilol	= 50 „	„ 1 pipe or butt.
„ quarter-kilol	= 25 „	„ 1 hogshead.
„ eighth-kilol	= $12\frac{1}{2}$ „	„ 1 quarter-cask.

A kiloliter standard, above sub-divided, should be kept at all the principal Breweries by the Local Authorities.

* The variation in the size of the hogsheads is owing to the importation of casks about this size, from different countries, which are retained when empty, instead of being returned.

† There are no casks of this size ; a leaguer is merely a quantity often spoken of. Thus, if a Farmer said he had 1 leaguer of brandy for sale, the Spirit Merchant would send 2 hhds. (perhaps holding 133 gals. or more) to fetch it.

One kilol = 10 hektols = 100 dekals = 1,000 liters = 1 ton of water = 1 cu. meter.

To convert dekaliters or "dekals." to gals., add 10 per cent. and multiply by 2, thus 100 dekals = (100+10) 2 gals. = 220 gals.

WEIGHTS.

THE IMPERIAL WEIGHTS include the **Metric** (the "Kilogram"* and its Decimal derivations), by Act of 1897, and the **Avoirdupois Weights.** Also the Troy Ounce and Apothecary Weights, both now derived from the Avoirdupois Pound, and both slowly becoming obsolete.†

AVOIRDUPOIS WEIGHT.

(avoir. or avdp.)

(Primary Unit, the Pound; see Act of 1878, secs. 13 and 14. The Pound is about **10 per cent.** less than the ½ kilogram or "Foreign pound.")

		1 grain, *gr.*
7,000 grains	=	1 POUND, *lb.*
(27 11/32 grains)	=	1 dram, *dr.* (practically obsolete).
16 drams	=	1 ounce, *oz.*
16 ounces	=	1 POUND, *lb.*
14 pounds	=	1 stone, *st.*
28 "	=	1 quarter hundredweight, *qr.*
112 "	=	1 hundredweight, *cwt.*
2,240 " or 20 hundredweight	=	1 ton, *t.*

100 pounds	=	1 cental (Order in Council 4 Feb., 1879). ‡
50 "	=	1 half-cental (" " " 9 Oct., 1903).

* Or Metric bi-pound, or double-pound. For comparisons see page 141.
† For comparisons of the Troy Ounce with Avoir. weights, see pages 85 and 86.
‡ By Sec. 8, 1878 Act.

Notes.

The Avoirdupois Pound :—

Commodities not sold by number or by price (other expressions are "by the piece," "the lot," "all at," "in bulk," "at sight," &c.), or by any of the Measures of Extension, are now nearly all sold by weight.

Even goods sold by the measures of Extension are often referred to weight also, such as yarns, barbed wire, corrugated iron, &c.

Avoir. and Metric weights for Medicines, are now given in the Pharmacopœia, instead of Apothecaries' Weight.

Avoir. weight is rapidly taking the place, too, of the Measures of Capacity for dry goods, the measures usually having now to be of specified weights. This is largely due to the practice of railway companies accepting goods by weight only.

The Imperial Ton, Hundredweight, Quarter and Stone, have generally been superseded in the Colonies, by denominations of 2,000 lbs., 100 lbs., 25 lbs., &c.

At the present time, therefore, reference is made to the "Avoirdupois Pound" in a very large percentage of commercial transactions.

The Avoirdupois Pound is deficient though in two things ; (*a*) it is divided into sixteenths ; (*b*) it has for ages lost all direct relation with the measures of extension, such as exists between the kilogram and decimeter.

(*a*) The division of the Avoir. pound into sixteenths is detrimental to Housekeepers and others buying in small quantities. For example, poor people, buying meat, &c., by semi-auction in poor neighbourhoods, are, as a rule, quite unable to follow the salesman in his rapid calculations, when he offers the piece "all at."

(*b*) If the pound were increased 10 per cent. in weight, it would be equal to the French pound, and therefore have direct affinity to the Metric measures of extension and capacity, all of which are decimally subdivided. Its value as a Commercial Unit would thereby be enhanced beyond estimation.

The Stone or 14 lbs. is a little heavier than 6 kilograms.

The Cental or "Short" Cwt., and Ton.

These are 100 lbs., and 2,000 lbs., instead of 112 lbs., and 2,240 lbs., respectively. They are the only standard cwt. and ton in Canada and South Africa (except in buying off a ship from England, &c.), and may also be authorised in some Colonies by the Governor in Council, some Government Official, Police Regulations or Market Authorities. This has more especially been done in Australia and New Zealand for certain staple commodities. Where short cwts. and tons are used, the denominations of the pound, or secondary standards, are 100 lbs., 50 lbs., 25 lbs., 15 lbs., 10 lbs., &c., instead of 112 lbs., 56 lbs., 28 lbs., 14 lbs., &c. (see page 115).*

The short cwt. and ton are also considerably used in the United States of America, in the Grain and Foreign Meat Trades, and for most commodities in Liverpool.

It is noteworthy that the ½-cental or 50 lb., which most of the Colonies have used for years, was only adopted by England on 9 Oct., 1903, to supersede the 56 lb. weight, at a time when the Colonies are thinking of adopting the Metric System with its 25 kilogram weight equal to 55⅛ lbs. Surely England "changes step" at the wrong time.

The Metric Cwt. and Ton.

As illustrated above, these are compromises between the ordinary or "long" cwt. and ton,† and the "short" cwt. and ton, for they weigh nearly the same as the long weight, but are decimally divided like the short weight.

---

* The Author is here referring to the Colonial Acts of Parliament, and the prevailing custom in the countries referred to, and was surprised, when recently at the Standards Office of the Board of Trade, to see standards of 56 lb., 28 lb. &c., being verified for Port Elizabeth, but no 50 lb., 25 lb., &c. From information obtained at this Department, it appears that it verifies the binary system of standards for all the over-sea Dominions; apparently from the standards verified at Home, the Colonies verify their own decimal series of pound weights.

† Twenty-one cwts. are sometimes called a long or "gross" ton. "Long weight" also includes tons of 2,400 lbs., and there are, in addition, American tons of 2,200 lbs., a number of space tons as on pages 50 and 51, and a tun of wine, page 66. The variety of tons has been known to cause loss of business to the country and even bankruptcies, through contracts entered into unknowingly, being either cancelled or enforced.

Counterpoise Weights for weighbridges, &c., are not a present required to be of any specified weights, but must b stamped with a mark of identification showing to which machin they belong, and may be used with such machine only.

Every proportional weight must be marked in legible letters o figures with the total weight of the standard weight which it wi balance on the platform of the machine to which it belongs, an the mark must be prefixed with the sign =.

If these weights were made illegal unless of some standar weight, they would not only be interchangeable from one machin to another, but could be used for all purposes, if properly marked thus 5 kilogs. = 500 kilogs.

Yarns.

(Cotton, Woollen, Worsted, Silken, &c.)

An old Act of 1776 relating to the measurement of yarns in England is still in force, but since the Metric Act of 1897, the Metric System is being gradually adopted by Spinners, Reelers, and Manufacturers, not only in England, but in all other countries,* instead of a labyrinth of local standards.

In 1900 an International Conference was held in Paris, Great Britain being represented. It decided upon an international system of count, namely "**a fixed weight with a variable count length.**" †

The unit was fixed at 1 meter equal to 1 gram. Number 1 count, therefore, means that a length of 1 meter weighs 1 gram. Number 100 count means 100 meters per gram, and so on.

For Raw and Thrown Silks the length is fixed and the weight is variable.

The "Silk Association of Great Britain and Ireland," feeling that "an uniform international count is impossible until there is an uniform system of weights and measures," and that "the metric system . . . is so perfect," resolved—

"That the Silk Association recommends the Government to adopt the Metric System of weights and measures."

---

* Consent of the Government of India given in 1902.

† This system is also adopted for wire, See "Barbed Wire," page 211.

In the meantime, the local counts, which are so inconvenient to our manufacturers, will continue. For Tables of Comparison, conversion diagrams and further information, see "International Yarn Tables," by M'Lennan, Blair and Co., Glasgow (publishers, J. and R. Parlane, Paisley).

Wool.

Wool is bought and sold at per pound.

In England, a quarter-hundredweight (28 lbs.) is sometimes called a "tod," and 240 lbs. a "pack": in the latter case the price in pence per lb. equals the price in Pounds sterling per pack, a method that is amplified with the Decimal System.

Hay and Straw.

In London and within a radius of 30 miles trusses must weigh as follows :—*

Straw, at least 36 lbs.

Hay, between August 31 and June 1, at least 56 lbs.

" " June 1 and August 31, "if of the summer's growth of that year," at least 60 lbs.

But, if several trusses are sold to the same person, a truss may be deficient in weight, so long as the average weight of all the trusses is correct. The bands must not exceed 5 lbs. per truss.

36 trusses go to the London load.

In Quebec certain small bundles of produce must weigh particular amounts.

---

* 36 George III. c. 88 (1796), sections 2, 3, and 6. The area of the operation of the Act has to a certain extent spread by custom. To give full effect to the Act of 1897 this Act requires amending (by Order in Council or otherwise), so as to read :—

36 lbs. or 3 trusses to 100 Metric pounds.
56 " or 50 Metric pounds.
60 " or 54 " "
5 " or 5 (or 4½) Metric pounds.

The amendment would not interfere with the stackman's method of cutting by measurement without weighing.

In South Africa the number of pounds to the bundle, bale, load are usually fixed by the Market Authorities, and differ b slightly throughout the Sub-Continent. All large quantities a sold at per 100 lbs. An ox-team load should weigh about 5,0 lbs.* ; and so on.

Hops.

In the Hop Trade it is provided (Act 39 and 40 George II c. 81, sec. 3) that the weight of the bag shall not exceed "th proportion" of 10 lbs. to every 112 lbs. gross weight of bag an hops. If Metric weight or the cental are used this proportion i practically 9 per cent.

Beer and Milk.

See page 64 for occasional sales by weight.

Potatoes, Salt, and other Staple Commodities.

These are often sold nominally by measure, but actually by weight, unless in very small quantities, or specially agreed otherwise.

Flour.

Flour is now usually sold by weight, throughout the Empire, at per lb., per cental of 100 lbs., or ton of 2,000 lbs.

Corn.

The United Kingdom :—The evidence before the Select Committee on "Corn Sales" (Parliamentary Paper, 279 of 1892) showed that Wheat, Barley, and Oats, are usually sold by weight, with the principal exception of superior barley in Norfolk. The Norfolk farmers, however, were then prejudiced against compulsory sale of malting barley on the system of "measure by weight" (*i.e.*, a fixed number of pounds to the bushel) because although a good barley, it was of light weight. They feared the buyers of barley (a few large firms of maltsters) would try and obtain the superior barley at the same price per weighed bushel, as the inferior barley, although all was sold by sample. It was pointed out that sale by measure, in their case, raised the price of Tithe not only for themselves, but for all Tithe-payers (see "Tithes," page 150).

* See "Loads," page 61. To convert lbs. to kilogs. divide by 2 and deduct 10 per cent.

The consequence of this divided opinion is that throughout the United Kingdom there are still about 30 different weighed measures in vogue, that is to say, nominal bushels, but different weights for those bushels. This state of affairs has often led to disputes, as pointed out by Mr. H. Williams, who was selected as a witness by the Associated Chambers of Agriculture. He said "two men can measure a bushel, one in the interest of the buyer and one in the interest of the seller, and arrive at an irreconcileable difference, through simply shaking the measure" (see "The Bushel," page 60).

For the purpose of making Corn Returns, statutory weights for the bushel of wheat, barley, and oats are fixed by the 1882 Act, as shown below, and Inspectors must reduce all sales to a common denomination accordingly, when sending in returns. Statistics are therefore altogether misleading; the "bushel by law" very seldom agreeing with the "bushel by fact."

Mr. Shuker, a farmer, pointed out that weight is the more substantial, more correct and quicker mode, and suggested that all grains should be sold wholesale in sacks of 112 lbs., because the usual four-bushel sacks (size 56 by 27) would take 2 cwt. of wheat, barley, beans, peas, and vetches, leaving only oats to be filled into somewhat smaller weight.

If it were made compulsory to sell all grains "at" per 100 Metric pounds (= 110¼ Imperial pounds), the wishes of those formerly advocating the cwt. unit would be met, and the change from Imperial to Metric denominations would probably be sufficient to prevent any undue advantage being taken by large buyers of malting barleys.

In addition to local variations within the United Kingdom, the Statutory bushels and customs differ in the various Dominions beyond the seas, as shown in the following table of—

STATUTORY BUSHELS.

	Wheat.	Barley.	Oats.
United Kingdom (Corn Returns Act, 1882, see page 24)	60	50	39
New South Wales	60	52 (Eng.) 50 (Cape)	40
W. Australia	60	50	40
Queensland	60	48	40
Newfoundland	60	48	38
Canada	60	48	34
Approximate average = 55, 45 and 35 Metric pounds respectively	60½	49½	38½

In Cape Colony cereals above 50 lbs. are sold "at" per 100 lbs. (Public Markets Acts, 33 of 1885); and in the Transvaal and Orange River Colonies a bag of wheat is 200 lbs.; of barley, 160 lbs.; and oats, 130 lbs.

If Metric "Weight" were adopted, the sales would probably at per 100 lbs. (metric), and if "measure by weight" were a employed, the statutory hektoliters for wheat, barley and oa would most probably be fixed at 150, 125 and 100 lbs. (metr respectively.

These changes would also facilitate the ascertainment of fit values as shown on page 150.

If Bread is to continue to be sold by weight, Co[rn] should also sold by weight, and the Returns published in weight.

Bread.

BREAD MUST BE SOLD BY WEIGHT.

See Acts of Parliament, page 23.

That weight must be Avoirdupois Weight, unless, in the Unite Kingdom and certain parts of the Empire, metric weight is used.

Only exception:—French or Fancy Bread and Rolls may, if not sol by weight, be sold (like other commodities) "by number," such a thirteen to the dozen, or "by price," such as a threepenny roll.

No kind of bread, therefore, may be sold by the measures o capacity or extension.*

In Scotland and Newfoundland the weight must appear on ever loaf.

The usual weights of loaves in the Colonies are ½, 1, 2, 3 and 4 lbs.

In the United Kingdom "the loaf" is not such a general term the 4-lb. loaf usually being meant, the 2-lb. loaf being called "the half-loaf." 1 lb. of flour makes more than 1 lb. of bread, because of the added water, &c. The ratio varies with the quality and kind of flour, evaporation, &c., hence a small difficulty at first arises in making loaves of specified weights, and in England the weight is often made up by throwing in a "jockey piece" or "make weight."

Meat.

The short cwt. is largely used in the Foreign Meat Trade, but otherwise meat weight is the same as any other weight (see Act,

* It is entirely wrong to put in School Table-books a "Table of Wheaten Bread," referring to quarterns, half-quarterns, &c. A 4-lb. loaf may still be sometimes vulgarly called a quartern loaf, but it is putting things the wrong way round, and creating an erroneous impression, to say a quartern loaf weighs 4 lbs. Mr. Chaney, in "Our Weights and Measures," points out that Bread was sold by weight even in Mosaic times (Lev. xxvi. 26 and Ezek. iv. 16).

1878, secs. 3, 14, 19 and 20). Formerly a stone of meat weighed only 8 lbs., which arose from the fact that a stone of 14 lbs., in the live animal (*i.e.*, including skin, hoofs and other matter) will only cut up into about 8 lbs. of meat. That is to say, a stone of 14 lbs. live weight makes about 8 lbs. dead or "net" weight. A stone of meat must now mean 14 lbs.

In the retail trade, as it is impossible to cut to exact weight, "money-weight" or "computing" scales are now coming largely into use.

Eggs.

A "Standard" dozen of eggs, in Canada, must weigh "at least" 1½ lbs. (Chap. 26, 1901, sec. 6). By the money-weight scale, eggs can be sold by weight as easily as apples. This system would operate in favour of the farmer, because English eggs are generally larger than imported ones. A "guaranteed weight," however, would not necessitate the weighing of all eggs.

Fish.

Fish is retailed by number or Avoir. weight. For certain local wholesale methods, see "Fish Measure," p. 62.

Coal and Coke.

Practically, throughout the Empire, both these commodities must be sold by weight, excepting that (1) coal may be sold wholesale by the ship, truck, &c., (2) in Newfoundland by measures containing 2 cwts. and 5 cwts., and cargoes wholesale by the chaldron; and (3) coke, when sold by retail, may, in some parts, be sold by the bag or sack of 3 bushels, 12 sacks or 36 bushels making one chaldron.

Local authorities may make bye-laws. In Scotland (Burgh Police Act, 1892, sec. 424) the weight of bags of 2 cwts. and under must be shown on labels.

Shipping Tons.

A Ton of Displacement refers as much as anything to the Metric ton (cubic meter of water), but Shipping tons of Merchandise, Timber, &c., refer to the Imperial ton. They are for convenience calculated in cubic feet, and are therefore more particularly explained under Cubic Measures, on pages 50 to 59.

Ostrich Feathers.

These are sold by the growers and wholesale dealers by t Avoir. oz. (28 grams), but retail by the feather. The "Met ounce" would be 25 grams.

Precious Stones.

Precious Stones are, properly speaking, sold by the Avoirdupo Grain, see page 86, and under the next heading we shall see Avoi weight is also used for Drugs.

APOTHECARIES' WEIGHTS AND MEASURES.

The enlightened character of the Medical Profession, and th ease with which the change could be made, has led to the adoptio of the **Metric System** in the British Pharmacopœia and the Phar macopœia of every Nation.*

Units :—The Cu. Centimeter and Gram.

Their Utility :—1 Cu. Centimeter of Water weighs 1 Gram.

"The facilities the Metric System gives to the making of preparations of standard strengths—that is to say, the simple relation of weight to volume—is a thing of supreme importance in making preparations of potent drugs."—*Mr. M. Carteigh, President of the Pharmaceutical Society* (before the Select Committee, 1895).

By the Medical Act of 1858 (amended 1862), sec. 54, the General Council of Medical Education and Registration of the United Kingdom are empowered to publish the "British Pharmacopœia"† containing the Weights and Measures to be used in Pharmacy.‡

---

* Many Foreign Customs Houses will not pass bottles of medicine sent from England. Every one who travels, therefore, should now have their prescriptions written by their Physicians in Metric terms.

† Spottiswoode & Co., Gracechurch Street, London (1898). This book is also in use throughout the Colonies and in India. Steps have been taken "preparatory to the ultimate production of a complete Imperial Pharmacopœia."

‡ By Sec. 55 the Act did not affect the Trade or Business of a Chemist in so far as it related to selling, compounding, or dispensing Medicines.

Weights.

In 1864 the General Council first directed the *sole* use of the *Avoirdupois* Grain, Ounce and Pound, as weights for preparing medicines, and published the following Table for Weights in the Pharmacopœia :—

	1 grain (avoir.),	*gr.*
437·5 grains	= 1 ounce „	*oz.*
7,000 grains or 16 ozs.	= 1 pound „	*lb.*

In the Preface of the book this remark is made : "It must be admitted that the absence in the present system of any denomination of weight between the grain and the Avoir. ounce of 437·5 grains, and the fact that the ounce is not a simple multiple of the grain, are grave defects."

The Council strongly urged all medical men to avoid the use of the terms ounce and pound with reference to any other than the avoirdupois or Imperial Standard Weight, but left it "optional" with the *Physician in prescribing* to use the two following symbols :—

℈, when referring to 20 grains (scruple) *
ʒ, „ „ „ 60 „ (dram).

In 1867 the alternative employment of the Metric weights was first published in the Pharmacopœia. In 1878 a "Consolidating" W. and M. Act was passed, and sec. 20 is the only section referring specially to Apothecaries Weight. It enacts that "all articles sold by weight, shall be sold by Avoir. weight ; except that . . . Drugs when sold by retail, may be sold by Apothecaries weight."

---

* The scruple and dram are survivals of what in the Standards Commission Report of 1870 was called the "Old" Apothecaries Weight in which the Troy ounce of 480 grains and the old Troy pound were used. It was as follows :—

		1 grain,	*gr.* (say 65 milligrams)
20 grains	= 1 scruple,	℈ („ 1⅓ grams)	
60 „ or 3 scruples	= 1 dram,	ʒ („ 4 „)	
480 „ „ 8 drams	= 1 Troy ounce,	℥ („ 30 „)	
5760 „ „ 12 ounces	= 1 "obsolete" Troy pound,	lb or *H.*	

The similarity between the symbols for the dram and ounce caused many accidents.

AUTHOR'S NOTE :—It is difficult to see the use of this part of the Act (which refers to Apoth. Weights and not Measures), considering (*a*) Avoirdupois denominations were adopted in the Pharmacopœia as far back as 1864 ; (*b*) the denominations of 20 grains and 60 grains are both Avoirdupois denominations (by section 14), and the former is obsolete ; (*c*) the only purpose for which the chemist may use the "heavy" Troy ounce is for *retailing* "drugs" which he has been compelled by law to buy wholesale by the "lighter" Avoir. oz., and (*d*) the old Troy pound formerly used by Apothecaries, and being "lighter" than the Avoir. lb., was abolished by sections 14 and 20 of the said 1878 Act. Further, in the United Kingdom, the Apothecary is almost an extinct person, being merged into the Medical man.

In 1897 an Act was passed permitting the sale of "all" articles by the Metric weights and measures. The simplicity of their arrangement, and minuteness of their smallest denominations render them incomparably fitter for the purposes of Pharmacy than the old illogical and cumbrous methods.

In 1898 a new edition of the Pharmacopœia was published, in which "the Metric System alone is employed in all paragraphs relating to analysis, whether gravimetric or volumetric."

In Gravimetric Analysis (analysis by weight), therefore, the only weights now used are the **Metric Gram.** and its decimal gradations.

For the Metric Weights, see page 142.

Measures of Capacity or Volume, or Apothecaries' Fluid Measure.

Nothing is said in any Weights and Measures Act in reference to Apothecaries' "Measures."

According to the Pharmacopœia, in the measurement of liquids, the Imperial measures of capacity are used for the higher denominations, and the Fluid Ounce and its subdivisions for the lower denominations.

In 1867 the alternative employment of the Metric Measures was first published in the Pharmacopœia.

In 1897 an Act was passed permitting the use of Metric Measures for "all" purposes.

In 1898 a new edition of the Pharmacopœia was published in which "the Metric system alone is employed in all paragraphs relating to analysis, whether gravimetric or volumetric." (But see Volumetric Analysis on page 81.)

The Fluid Ounce.—It is an error to suppose that the Troy ounce, of 480 grains, is the basis of the fluid ounce; if it were, 20 fluid ounces would not equal a pint, for "a pint of pure water weighs a pound and a quarter," *i.e.*, Avoirdupois weight.*

Yet so confusing have the measures used by chemists become, that many of their assistants do not even know the basis of the fluid ounce they use.

The fluid ounce is the volume of 1 AVOIR. oz. weight (437·5 grains) of distilled water at 62° Fahr.

Having formerly been accustomed, however, to use the Troy ounce of 480 grains, Apothecaries have divided the Avoirdupois fluid ounce of 437·5 grains' weight (when containing water) into 480 equal parts, called minims, and formed the following table (published in the Pharmacopœia) :—

	1 minim, *min.* or ♏
60 minims	= 1 fluid dram, $f\mathfrak{Z}$
8 fluid drams	= 1 fluid ounce, $f\overline{3}$
20 fluid ounces	= 1 pint, *pt* or *O*
8 pints	= 1 gallon, *gal.* or *C.*, or *Cong.*

Therefore a minim "of water" weighs $\frac{437{\cdot}5}{480}$ or $\cdot 9114583\dot{3}$ grains.

This necessitates the publication in the "Pharmacopœia" of the following table, showing :—

THE RELATION OF VOLUME TO MASS.

1 minim is the volume at 62° F. of		0·9114583	grains of water.
1 fluid dram	"	54·6875	"
1 " ounce	" 1 ounce or	437·5	"
1 pint	" 1·25 pounds or	8750·0	"
1 gallon	" 10 "	70,000	"
109·7143 minims† = the volume, at 62° F. of		100	"

* Formerly a pint of water weighed a pound, when the symbol for both was lb.

† Taken as 110 minims throughout the Pharmacopœia.

The fluid ounce being a measure of volume, it follows that a fluid ounces are not of the same weight; thus 1 fluid ounce of water weighs 1 oz. avoir.; a fluid ounce of glycerine weighs 1·26 oz. avoir., ether only ·72 oz. and so on.

Roughly :—One-half wine-glassful = 2 table-spoonfuls = 4 dessert spoonfuls = 8 tea-spoonfuls = 8 fl. drams = 1 fl. ounce but graduated glass measures are safer.

The use of these measures is rendered more necessary because Apothecaries' Measures fail to convey to the mind of the ordinarily educated individual any definite quantity.

IN VOLUMETRIC ANALYSIS (analysis by volume) the only Measures used are what might be termed the "English" liter and the "English" cubic centimeter. For where foreign physicists and chemical analysts would use the liter and *milliliter* to represent the volume of 1000 grams and one gram respectively of distilled water at 4° C. (39·2° F.) their British brethren use measures bearing the names of liter and *cubic centimetr* to represent the volumes of the same weights of water, but standardised at 60° F., and therefore of larger capacities. Can anything be more inconsistent than the fact, that when we British do take over the Metric System, we neither standardise at the temperature adopted by all the rest of the world (namely 4° C., at which water is at its greatest density), nor yet at the temperature of our own Imperial weights and measures, which are standardised at 62° F.?

The result of our folly is, that, owing to the fact that 1 gram weight of water has a bigger volume at 60° F. than at 4° C., *our* cubic centimeter is greater than a milliliter, whereas, according to the Continental system, the actual cubic centimeter has been found to be theoretically less than the milliliter.

For the actual *Metric Measures of Volume and Capacity see pages* 140 *and* 144.

Summary.

Many British Apothecaries and some Physicians therefore, instead of using the simple Decimal Metric Weights and Measures as used in all Foreign Countries, are to-day practising with the following :—

Non-decimal Weights and Measures—

(1) The Avoir. grain, ounce and pound, but not the Avoir. dram.

(2) Subdivisions of the Troy ounce divided into scruples and drams instead of decimally or into pennyweights.

(3) Occasionally the obsolete Troy pound of lighter weight than the Avoir. pound.

(4) The fluid ounce, being the volume of 1 avoir. oz. of water at 62° F., which weighs 437·5 grains, divided (like the Troy oz.) into 480 equal parts. To the uninitiated the fluid ounce sounds like a weight, but it is a measure of volume and therefore its weight varies for different chemicals. Its multiples are expressed in ordinary pints and gallons.

(5) The fluid dram of water at 62° F. weighing exactly "2" Avoir. drams.

(6) Tea, dessert and table spoonfuls of varying sizes, and sometimes wine glassfuls and cupfuls.

Decimal Measures—

(7) Volumetric Measures, with official Metric names, but graduated at 60° F. instead of at 4° C. (39·2° F.)

(8) Grams in Gravimetric analysis.

Surely we have no right to laugh at the Chinese about their weights and measures, when our own are in such a deplorable muddle.

A few Symbols used by Apothecaries.

s.s., one half; *a.a.*, of each; *gtt.*, drops; and the Roman numerals sometimes dotted with a line between the stroke and the dot $\dot{i}$ $\dot{ii}$ $\dot{iii}$ and so on.

WEIGHTS FOR THE PRECIOUS "METALS."

(NOTE.—*Weights for Precious "Stones" are considered on p*
86 *and* 87.)

By the Weights and Measures Act of 1897, the Metric We
may be used in the *United Kingdom* for "all" purposes.
practical use in weighing precious metals, all weights ma
expressed in Grams only, or in Grams and Kilograms (for c
parisons see page 142).

1,000 grams = 1 kilogram or kilog.

The Royal Mint, Royal School of Mines, and all the princ
assayers now use the millesimal system of fineness (so many p
in 1,000), as distinct from the carat system of ratios still emplo
by retail Goldsmiths. This is a great step towards the adoptio
the International Metric System for the precious metals. It sho
be noted that the Standards Commission, in their Third Rep
dated February 1, 1870, recommended the abolition of T
Weight, but until the Pound Sterling is declared to be of
weight of 8 grams (see "Weight of the Sovereign," page 93), bull
dealers will most probably continue to use the Troy ounce.

Troy Weight.

The Law on this subject varies in different parts of the Empi
It is generally very loosely administered. In the United Kingdo
Troy Weight is derived from Avoir. Weight. In many of t
Colonies the reverse is the case. The effect of the Imperial A
of 1878, too, is to divorce the weights for the precious metals fro
those used for precious stones. To ascertain the cause, we ma
trace the history of Troy Weight from 1824.

This Standard Troy Pound was destroyed in the Fire at the Houses of Parliament on October 16, 1834.

In 1855 an Act (18 and 19 Vict., chap. 72) was passed, and narrated in the preamble that the Standard Troy Pound having been destroyed, in future (by sec. 4), the standard weight for Reference should be the "Avoirdupois Pound" of 7,000 grains and the 1824 Act, inasmuch as it relates to the Troy Pound being restored, was repealed (sec. 1).

In 1870, the Standards Commission recommended the abolition of Troy Weight. In the same year it was found that only a few towns had copies of the Standards.

In 1878 the "Weights and Measures Act, 1878" (styled the principal Act) repealed all provisions in previous Acts on the subject of standards and their gradations, and in part carried out the recommendations of the Commission, for it enacted :—

Section 13.—The Avoirdupois Pound shall be the only standard measure of weight, and all other weights shall be ascertained from it.

Section 14.—$\frac{1}{7000}$ of the Avoirdupois Pound shall be a grain, and 480 of such grains shall be a Troy Ounce.

All Imperial Weights (and therefore including the Grain) shall be deemed to be Avoirdupois weights, except the Troy Ounce.

Section 20.—All articles sold by weight shall be sold by Avoirdupois weight, except that gold and silver and articles made thereof, also platinum and other precious metals, "may" be sold by THE TROY OUNCE, or by any DECIMAL PARTS of such ounce.

Schedule 2 enumerates the decimal denominations under the heading of Troy Bullion Weights, but the gradations do not include ·25 or ·15 of the ounce, equal to the abolished 5 dwts. and 3 dwts. ; these are found, however, in the next column (Avoirdupois Weights), the schedule having been very badly compiled, which has caused confusion of thought regarding Troy Weight.

The effect of the 1878 Act, therefore, is that in all sales after December 31, 1878, all pennyweights should be expressed as decimal parts of the ounce, and as formerly 20 pennyweights made 1 ounce, all pennyweights are easily convertible into decimal parts of the ounce by dividing by 2. Thus :

Old Dwts.	Decimal part of Oz.	Old Dwts.	Decimal part of Oz.
1	·05	11	·55
2	·1	12	·6
3	·15	13	·65
4	·2	14	·7
5	·25	15	·75
6	·3	16	·8
7	·35	17	·85
8	·4	18	·9
9	·45	19	·95
10	·5	20	1·0

That is to say by the 1878 Act :—

The Troy pound is obsolete.

The Troy pennyweights must be converted into decimal parts the Ounce by dividing by 2.

The Grain is an "Avoirdupois" Weight, and may not be used weighing precious metals conjointly with the Troy Ounce.*

And, by Section 20, for weighing the precious metals, THE ONL LEGAL DENOMINATIONS OF TROY WEIGHT ARE :—

THE TROY OUNCE AND DECIMAL PARTS THEREOF.

The term decimal includes, as is usually the case, centesimal an millesimal parts (see Schedule 1878 Act).

To describe the "Carat" as a "Bullion Weight" creates a wrong impression (see pages 89 and 90).

In Canada (sec. 22, chap. 104, 1886), South Australia (sec. 15, Act 349, 1885), Natal (sec. 70, Law 19 of 1872), South Nigeria (schedule of Proclamation 7 of 1901), the law is the same as in the United Kingdom.

In Australia (except South), New Zealand, South Africa (except Natal), Ceylon, Newfoundland, &c., the Acts are so framed that the law is as it stood in England in 1824, and the Troy Pound of 1758, destroyed by fire in 1834, is the basis, being divided as follows :—

		1 grain,	*gr.*
24 grains	=	1 pennyweight,	*dwt.*
20 pennyweights	=	1 ounce,	*oz.*
12 ounces or 5,760 grains	=	1 pound,	lb.

(NOTE.—The symbol for a Troy pound is lb ; for the Avoir. pound, lb.).

The Troy Ounce is "heavier" than the Avoirdupois Ounce, in the proportion of about 80 to 73 (namely 192 to 175) ; but, where authorised, the Troy pound is "lighter" than the Avoirdupois pound

---

* Auctioneers are the worst offenders against these three facts, and are liable to penalties under sections 19, 23, and 24.

(4) The old Troy Pound, still surviving in Australia, &c., equal to the brass weight of 1758, which was destroyed in 1834.

(5) The ancient Arabic carat of about 4 "pearl" grains.

(6) The pearl grain, lighter than the avoir. grain.

And the following, which is simple as well as legal (since 1897), but at present rarely used :—

(7) The metric centigram and milligram, sufficiently delicate to weigh any fractional part of the carat, pearl grain or avoir. grain, and as easily understood by the purchaser (who is the one to be considered).

INTERESTING ITEMS—Gold and Silver.

"**Fine**," "**Fineness**," or "**Millesimal fineness**" are terms denoting the number of parts of pure metal in 1,000, the remainder being alloy ; thus "900 fine" denotes 900 of pure metal to 100 of alloy. This system is superseding the carat system of referring to alloys (see below).

"**Remedy.**"—A variation in the fineness of gold coins of 2 parts in 1,000 and also in the weight is allowed ; in silver coins 4 parts in 1,000 are allowed. The permitted variation in the fineness and weight is called the "remedy," or "remedy allowance." Formerly the allowance for fineness was greater for gold coins owing to the inability to remove the traces of silver existing in the natural gold. When silver was used as an alloy in gold coins as well as copper, it gave the gold a pale yellow colour. Until recent years it was used for Australian sovereigns.

Carat.—The word "Carat" refers not only to the ancient Arabic weight used for precious stones, but is also a term applied to the ratio of alloys of metals, namely "so many parts out of 24." At the Royal Mint, &c., *the Carat System of alloys is being displaced by the Millesimal system* (see above).

Standard Gold is 916·66 fine, or 22 parts out of 24 (22 carat).

Standard or Sterling Silver is 925 fine* or $\frac{37}{40}$, equal to 22·2 carat, or, expressed in another way, 11·1 ozs. out of 12 ozs. (in

* In India it is the same as gold, namely 916 $\frac{2}{3}$ or $\frac{11}{12}$. In foreign countries it is 900 or $\frac{9}{10}$.

old denominations this equals 11 ozs. 2 dwts. out of 1 lb. Troy) a quantity out of which 66 shillings are coined; 5½ shillings are therefore coined out of 1 oz. standard silver.

Coins, other than "bronze," are always made of standard gold or standard silver; copper is the alloy used in both cases. Bronze coins are weighed by Avoir. weight. See above "Remedy" and "Money," page 91.

Gold Wares.—In addition to 22-carat gold, the following are allowed to be Hall-marked: 18, 15, 12 and 9 carat, and in Ireland a ratio of 20 out of 24 is also permitted.

Silver Wares.—These are mostly made from standard silver, but 23 carat (11½ ozs. out of 12 ozs.) is an authorised proportion, which, after a considerable lapse of time, is coming into fashion again for high-class plate.

Legal Marks for Gold and Silver:—

The Hall Mark shows the assay town, *e.g.*, London, a leopard's head.

The Standard Mark, the standard, *e.g.*, a lion passant for Silver (Ireland, Hibernia) and a crown, with figures (*e.g.*, 18 for Gold).

The Duty Mark was the head of the Sovereign (duty abolished 1890).

The Date Mark for London is one of the first twenty-one letters of the alphabet (excluding J) denoting the year of manufacture: the letter is changed yearly, and the *style* of letter every twenty years.

The Maker's Mark, or initials.

Specific Gravities:—

Gold, pure	19·351
„ standard	17·724
Silver pure	10·474
„ standard	10·312

Declaration of Gold Outputs are apt to be very misleading, as they are not made in ounces of fine or pure gold, except on the Witwatersrand (see next page).

Bullion is alloyed (as distinct from pure) gold or silver in the mass. "Standard bullion" is generally meant when "bullion" is spoken of.

The Bank of England and all bullion dealers at present* use the standard troy bullion weights, which are in decimal multiples and sub-multiples of 1, 2, 3, 4 and 5 ounces, from 0·001 ounce to 500 ounces (Act 1878, schedule 2).

Throughout the Empire, the free coinage of Gold Bullion is authorised (see sec. 8 of 1870 Coinage Act, page 25, and the recent Indian Coinage and Currency Acts).

For fineness of Imperial, Indian and Foreign Silver Bullion see footnote on page 94.

WANT OF UNIFORMITY

IN DECLARING

GOLD OUTPUTS.

The following is taken, by kind permission, from the Johannesburg "Star," dated March 10, 1902 :—

"Since the resumption of milling commenced in May, 1901, the output of gold in the Witwatersrand has been declared in fine gold, the value of which is £4 4s. 11·4545d. per oz. The custom previously obtaining, was to declare returns in bullion ozs., the value being taken for purposes of estimation at £3 10s. per oz. for mill gold, and £3 per oz. for cyanide gold. We believe that with the exception of the United States, where the value of gold won is declared in dollars, the Transvaal is the only country in the world which has made the fine ounce of gold the standard of declaration. The great advantage of the new system is that now every one knows that when an ounce of gold is spoken of, a money value of £4 4s. 11½d. is referred to, whereas formerly a bullion ounce might be of any value from £2 upwards. Further, if statistics are to be of any real value the standard of the ounce of gold must

* See "Weight of the Sovereign," page 93.

be a fixed quantity, and not vary as it does in the different colonies of the Australian Commonwealth. In Victoria the value of an ounce of gold is £3 19s. 0½d., in Tasmania it is £3 17s., in Western Australia £3 16s., New South Wales £3 9s. 1½d., South Australia £3 8s., Queensland £2 19s. 7½d., and in New Zealand £3 7s. 0¾d. It is greatly to be hoped that other countries will adopt the same practice that has now come into vogue on the Rand, and declare the production in fine gold."

AUTHOR'S NOTE.—If the pound sterling were defined as of exactly eight grams (*see* "Weight of the Sovereign," page 93), the value of the gold won would be declared in British sovereigns, in a manner similar to that adopted in the United States, and with the supreme advantage that by multiplying the number of sovereigns by eight and deducting one-twelfth (on account of the copper alloy in the sovereign), the weight in grams of the pure gold won, would be ascertained.

MONEY.

For certain Colonial Moneys, see pages 98 *and* 99.

For Indian Money, see page 166.

Gold is the sole standard of value; it is allowed to be coined freely, whereas silver is not (sec. 8, 1870 Act, page 25).

IMPERIAL SYSTEM.

Accounts are kept in pounds, shillings, pence and fractions, but the "Money of Account" is the Sovereign.

		1 farthing, ¼*d.*
4 farthings	=	1 penny, *d.*
12 pence	=	1 shilling, *s.*
20 shillings	=	1 pound or sovereign £

No person is obliged to give change.
A "Guinea" is twenty-one shillings (£1 1s. 0d.)

Imperial Coinage.

The following are the coins now in general use :—

Gold :— THE POUND STERLING OR SOVEREIGN, £.

					Decimal parts of £1.
	Half-sovereign	=	10s. 0d.	=	·5
Silver :—	Crown	=	5s. 0d.	=	·25
	Double-florin	=	4s. 0d.	=	·2
	Half-crown	=	2s. 6d.	=	·125
	FLORIN OR ONE-TENTH OF A POUND*	=	2s. 0d.	=	·1
	Shilling	=	1s. 0d.	=	·05
	Six-pence	=	6d.	=	·025
	Three-pence	=	3d.		
Bronze:—	Penny	=	1d.		
	Half-penny	=	½d.		
	Farthing	=	¼d.		

For full list of denominations minted in the last thirty years, see First Schedule to 1870 Coinage Act (now printed as revised by Coinage Act of 1891), which also gives the standard fineness, and the standard weight and remedy allowance in Grains and Grams, of all the coins, and the least current weight of the gold coins.

It should be remarked, however, that by sec. 11 of the 1870 Act, which is given *in extenso* on page 25, the denominations may be varied or withdrawn† from time to time by proclamation.

For mental conversion of all amounts into decimal parts of a pound, see rule page 195.

Paper Currency.—Paper money is always liable to be over-issued, and therefore depreciate. To avoid depreciation, in all British monetary arrangements, paper currency is always convertible into gold (or in India, into gold or silver). The Bank of England notes are therefore "payable to bearer on demand." They are issued for sums of £5, £10, £20, £50, £100, £200, £500 and £1,000.

* Both these descriptions appear on many 2s. pieces.
† As the groats or four-penny pieces have been.

Standard Gold is an alloy of eleven parts of gold to one copper, or 916⅔ gold to 83⅓ copper. This is known as a millesim fineness of 916⅔, and is also equal to 22-carat.* A "remedy" only two parts in 1000 is now allowed.

Two hundred and forty Troy ounces of standard gold are coine into 934 sovereigns and one half-sovereign (see First Schedul 1870 Act). Thus the legal rate of standard gold is £3 17s. 10½d. pe troy ounce, and of pure or "fine" gold upon the same basis, abo £4 5s. 0d. (£4 4s. 11·4545d.) per troy ounce.

Unless an Act is passed for improving the coinage, as in 189 light gold coins are only taken by the Bank at actual weight.

WEIGHT OF THE SOVEREIGN.

The standard weight of the sovereign is 7·98805 grams o 123·27447 grains. The least current weight is 7·93787 grams When issued the weight may vary between 8·00101 and 7·9750 grams (a margin of ·01296 grams each side of standard weight) The standard weights of all gold coins must necessarily b proportionate.

If the standard weight of the sovereign were defined as eigh grams exactly,† by a stroke of the pen, Troy Weight woul instantaneously and naturally die, for the Bank of England an Bullion dealers would immediately use only Metric Weights (a present 11 parts of gold are weighed by Troy Weight an apparently 1 part of copper alloy by Avoir. Weight).

A firm basis for declaring the value of gold won in mining operations would be established.‡

Such a change would raise the value of the sovereign less than ¾d., a difference below the remedy allowance, and nothing com-

* For explanation of these terms see page 88.

† As long ago as 1870, the Master of the Royal Mint reported that the substitution of Metric Weight for Troy Weight would be attended not only with no difficulty as regards the Mint, Bank of England, &c., but with advantage to the public (also see Third Report of the Standards' Commission, 1870, pg. v, lines 10 to 15). Metric Weight has already been employed in the Mint on the occasion of the large issue of copper "cash" to Hong Kong and China, each of these small pieces weighing 1 gram, and therefore 1,000 cash = 1 kilogram, value 1 dollar.

‡ See page 90.

pared with the enormous changes made in the weight and value of the standard sovereign in the past. Many pre-Edwardian coins would necessarily be rendered a trifle light weight, but could continue to circulate under a Light Coinage Act until gradually replaced.

No one must suppose that adding a small quantity of standard gold to the sovereign would mean a loss to the Mint or the country, or to any one, unless we except the infinitesimal cost of reminting coins struck in the last reign. The purchasing power of the sovereign would be increased.

See "Dispute as to Decimal Coinage," page 156.

Standard or Sterling Silver is an alloy of 37 parts of silver to 3 of copper, or 925 silver to 75 copper. This is known as a millesimal fineness of 925,* and is also equal to 22·2 carat. A remedy of only 4 parts in 1,000 is now allowed.

Twelve Troy ounces of standard silver are coined into 66s., the melting up value of which varies, but is now about 26s. Thus the *coining* value of silver per Troy ounce in the United Kingdom is 5s. 6d., and the present melting up value under 2s. 2d. For this reason silver coins are legal tender up to two pounds only (sec. 4, 1870 Act), being merely token money, and the Bank will therefore take light silver coins at face value.

A standard shilling weighs 5·65518 grams, or 87·27272 grains, and other silver coins are in proportion.

For the actual and nominal values of our silver coins to be identical, gold and silver would require to have a fixed ratio to one another of 14⅓ to 1.

Bronze is an alloy of copper 95 parts, tin 4, and zinc 1. No remedy is allowed for bronze coins. 16 *Avoir.* ozs., or 1 Avoir lb. of 7,000 grains of bronze are coined into 48 pence, or 80 half-pence, or 160 farthings. A penny, therefore, only contains five-

* Fineness of Standard Silver:—

In United Kingdom, &c.	925 or $\frac{37}{40}$.
In India (same as gold)	916⅔ or $\frac{11}{12}$.
In foreign countries	900 or $\frac{9}{10}$.

sixths the amount of bronze contained in two half-pence or four farthings. Bronze coins are only legal tender up to 1s. 0d. (Sec. 4, 1870 Act), being token money only, and light bronze coins are taken at face value.

All our Coins should, as far as possible, have a simple practical relationship with the smaller weights and measures of extension, an idea which originated with the first coins ever made. At present, in the United Kingdom,* the bronze coins are the only ones which have, namely :—

One penny	=	$\frac{1}{3}$ avoir oz.
One half-penny	=	$\frac{1}{5}$ „ „ and 1 inch in diameter.
One farthing	=	$\frac{1}{10}$ „ „

COIN AND BANKERS' WEIGHTS.

(See Weights and Measures Act, 1878, page 26.)

Coin-weights, or weights representing the "standard" weight of each coin of the realm, and Remedy-weights representing the "full" and the "least current" weights for gold coins, are allowed to be used, but must be forwarded to the Standards Office of the Board of Trade to be verified and stamped. For weights of coin-weights in grams and grains, see Schedule 2 of the Weights and Measures Act of 1878, or, as they are equal to the weights of coins, the schedule of either of the Coinage Acts of 1870 and 1891.

In addition to the authorised coin-weights for single coins, Bankers, to avoid counting gold, coin by coin, use balances with graduated scales, or sovereign weights in multiples of the sovereign, namely 50, 100, 200, &c., and the weights are so marked, but for such weights Board of Trade Standards for verification have not been deemed necessary, dealings between bankers and their clients being by coin and not by weight. The basis for these weights is

* A large issue of copper "cash" has been made by the Mint to Hong Kong and China. Each of these small pieces weighs 1 gram. Therefore 1,000 cash = 1 kilogram, value 1 dollar.

generally the estimated average weight of the sovereign in circulation at the time. Thus, before the passing of the Light Coinage Act of 1891, the average for a sovereign was taken at 7·96314 grams, and after the light gold was called in the average was raised to 7·97027 grams.

For bullion weights see page 90.

Weights for weighing silver are not much used by Bankers, light silver being taken at face value. But the average current weight of silver coins is sometimes taken at 35·2 oz. troy for every £10.

COMPARISONS OF THE "MONETARY UNITS" OF THE WORLD.

Standard, the British Sovereign.

Explanatory Notes on the Table on pages 98 to 102 :—

All countries (excluding China) have gold coins, but keep their accounts in denominations, which are made of silver, excepting that in—

Great Britain and most British Colonies	"the money of account" is the gold	British pound.
Egypt	„ „ „	Egyptian „
Turkey	„ „ „	Turkish „
United States, Canada, &c.	„ „ „	Dollar.
Portugal	„ „ „	Milreis.

These facts make it particularly difficult to appreciate a table of comparisons, because although the gold coins, which are multiples of the silver coins, do not fluctuate in value materially,* yet the silver denominations, for the purposes of exchange, considerably vary in value with the price of silver.

THIRD COLUMN (Number of coins receivable for £1 at par) :—Most very large sums are, for the reason just given, payable in gold,

* For the purpose of this table all fluctuations of gold may be disregarded. A small fluctuation, however, occurs through countries being from time to time indebted to one another, from the result of inter-commerce, &c., so that when gold has to be sent from one country to another it depreciates by what may be taken as the amount of the insurance.

and we may therefore take the British sovereign as "The World Monetary Unit," and first compare the gold coins of foreign countries with it, as in the last column, and then assume that in those countries silver is worth its face value, in the same way as we assume twenty shillings worth a sovereign. On this assumption we arrive at the figures appearing in the "third column," being those required for converting pounds sterling into foreign money and given in decimals because the monetary units of all foreign countries (except India and Persia) are divided decimally or centesimally.

Until Great Britain adopts a decimal system of count for her coinage, to convert shillings, pence, and farthings to a decimal part of the pound, "mentally" use some such rule as that given on page 195.

FOURTH COLUMN. (Figures for converting foreign moneys into pounds sterling by multiplication) :—The fourth column is the converse of the third. Thus, if 25·2 francs make one pound, to convert francs to pounds we can divide by 25·2 or $25\frac{2}{10}$, or, what is equivalent to so doing, multiply by ·0397.

These figures ·0397 show the par value of one franc in pounds sterling. To convert decimal parts of a pound to shillings, pence and farthings, multiply by 20, 12, and 4. Thus £·0397 = $9\frac{1}{2}$d.

FIFTH OR LAST COLUMN.—The nearest foreign denominations in gold to the pound sterling are marked (*G*). Excluding Great Britain, Egypt, and Turkey, the "monetary units" (or denominations in which accounts are kept) already named in the second column, are marked in the last column in the cases of the United States and Portugal (*g*), and otherwise (*s*). At face or par value they are generally one-tenth the value of the highest gold coin circulating in the country referred to, but this par value in pounds sterling, having already been shown in the fourth column, the values in this last column have been calculated on the supposition generally assumed by bi-metallic countries, that "pure" gold has a fixed ratio to "pure" silver of $15\frac{1}{2}$ to 1, which gives $60\frac{7}{8}$d. as the value per ounce of "Imperial standard" silver.

These monetary units are generally divided decimally by nickel or bronze coins, denoted by (*n*) and (*b*) in the last column.

TABLE.

Country.	Money of Account.	Number of Coins receivable for £1, at par.	Multiplying figs. to convert, at par value, into Pounds Sterling; with result.	Remarks. (*G*) gold coin, (*s*) silver, (*n*) nickel, (*b*) bronze. Silver at 60$\frac{7}{8}$d.
Argentina ...	See South American States.			
Austria-Hungary ...	Silver KRONE or Crown of 100 hellers.	24·0	·0416 (10d.)	20 krone (*G*) = 200d. = 16s. 8d. 1 krone (*s*) = 8$\frac{3}{4}$d. 10 hellers (*n*) = 1d.
Belgium * ...	Same as France.			
Brazil	Silver MILREIS (1000 reis)	8·9	·1124 (2s. 3d.)	10 milreis (*G*) = 22s. 5$\frac{1}{2}$d. 1 milreis (*s*) = 2s. 0$\frac{3}{4}$d. 40 reis (*b*) = 1d.
Britain, Gt., and Ireland ...	Gold POUND of 20 shillings (= 10 florins)	1·0	1·0	Pound (*G*) = 20s. 0d. Shilling (*s*) = 11d. Penny (*b*) = 1d.
British Empire—Australasia ...	Same as Great Britain †			
B. Honduras } Canada }	Gold DOLLAR of U. States.			
Ceylon ...	Silver RUPEE (Indian)	15·0	·06 (1s. 4d.)	15 rupees (*G*) = 20s. 0d. 1 rupee (*s*) = 1s. 10$\frac{3}{4}$d. ‡ 10 cent = 1$\frac{1}{2}$d.
E. African Pte. Egypt ...	Silver RUPEE See below.	15·0	·06	(Same as India.)
India... ...	Silver RUPEE of 16 annas	15·0	·06 (1s. 4d.)	15 rupees (*G*) = 20s. 0d. 1 rupee (*s*) = 1s. 10$\frac{3}{4}$d. 1 anna = 1d. 1 pice (*b*) = $\frac{1}{4}$d. 1 pie = 1$\frac{1}{2}$d.

* See "The Latin Union," page 103.
† See "Acts," p. 20.
‡ Par value of Rupee is 1s. 4d. See end of Explanatory Notes and page 166.

TABLE (*continued*).

Country.	Money of Account.	Number of Coins receivable for £1, at par.	Multiplying figs. to convert, at par value, into Pounds Sterling; with result.	Remarks. (*G*) gold coin, (*s*) silver, (*n*) nickel, (*b*) bronze. Silver at 60$\frac{7}{8}$d.
British Empire— (*continued*)				
Hong Kong, Labuan, Straits Settlements	British and Mexican Silver DOLLAR	Identical with the Japanese "Yen."		
Mauritius ...	Same as Ceylon.			
Newfoundland	Gold DOLLAR	of U. States.		
South Africa	Same as Great	Britain		
Bulgaria * ...	Same as France.			
Chili, Columbia	See South American States.			
China	Silver TAEL of 10 mace or 100 conderin or 1000 cash	3·07 (varies)	·326 (6s. 6$\frac{1}{2}$d. varies)	1 tael (*s*) = 6s 6$\frac{1}{2}$d. 10 mace = 8d. 1 conderin or 10 cash = about $\frac{3}{4}$d.
Denmark, Sweden and Norway	Silver KRONE or Crown of 100 öre	18·2	·055 (1s. 1$\frac{1}{2}$d.)	20 krone (*G*) = 22s. 0$\frac{1}{2}$d. 1 krone (*s*) = 1s. 1$\frac{1}{2}$d. 10 öre = 1$\frac{1}{4}$d.
Egypt	Gold E. POUND of 100 piastres	0·985	1·015 (20s. 3$\frac{1}{2}$d.)	1 E. Pound (*G*) = 20s. 3$\frac{1}{2}$d. 10 piastres (*s*) = 2s. 0$\frac{1}{2}$d. 1 piastre = 2$\frac{1}{2}$d. 1 mil (*n*) = $\frac{1}{4}$d.
England ...	See Britain.			
Finland * ...	Same as France.			

* See "The Latin Union," page 103.

TABLE (*continued*).

Country.	Money of Account.	Number of Coins receivable for £1, at par.	Multiplying figs. to convert, at par value, into Pounds Sterling; with result.	Remarks. (*G*) gold coin, (*s*) silver, (*n*) nickel, (*b*) bronze. Silver at 60⅞d.
France * and the Latin Union	Silver FRANC of 100 cents	25·2	·0397 (9¼d.)	25 francs (*G*) † = 19s. 10d. 20 francs (*G*) = 15s. 10½d. 5 francs = 3s. 11½d. 1 franc (*s*) ‡ = 8⅝d. 10 centimes (*b*) = 1d.
Germany ...	Silver MARK of 100 pfennige	20·4	·049 (11¾d.)	20 marks (*G*) = 19s. 7d. 1 mark (*s*) = 10½d. 10 pfennige (*n*) = 1d.
Great Britain ...	See Britain.			
Greece * ...	Same as France.			
Holland and Dutch East Indies	Silver FLORIN of 100 cents	12·1	·0826 (1s. 7¾d.)	10 florins (*G*) = 16s. 6½d. 1 florin (*s*) = 1s. 8d. 10 cents = 2d.
Indo-China ...	Silver PIASTRE	4·8	·2084 (4s. 2d.)	5 piastres (*G*) = 20s. 10d. 1 piastre (*s*) = 4s. 2d.
Italy *	Same as France.			
Japan and certain Brit. Possessions	Silver YEN of 100 sen	9·76	·1025 (2s. 0½d.)	10 yens (*G*) = 20s. 6d. 1 yen (*s*) = 4s. 3¼d § 10 sen = 2½d. 1 sen = ¼d.

* See "The Latin Union," page 103.

† In most Union countries, the highest gold coin is a 20-franc piece.

‡ The face value of the franc is 9½d., but all higher silver denominations in the Latin Union are face value with standard silver at 60⅞d. per oz.; compare the 5-franc piece here shown.

§ Par value, 2s. 0½d. In Japan gold bears a ratio to silver of 32·348 to 1 (see end of "Explanatory Notes").

TABLE (*continued*).

Country.	Money of Account.	Number of Coins receivable for £1, at par.	Multiplying figs. to convert, at par value, into Pounds Sterling; with result.	Remarks. (*G*) gold coin; (*g*) gold coin, also a monetary unit; (*s*) silver; (*n*) nickel; (*b*) bronze. Silver at 60⅞d.
Mexico... ...	Silver PESO of 100 cents	4·946	·202 (4s. 0⅜d.)	5 pesos (*G*) = 20s. 2⅜d. 1 peso (*s*) = 4s. 3⅜d. 10 cents = 5d. 1 cent = ½d.
Norway ...	Same as Sweden and Denmark.			
Ottoman Empire* ...	Gold T. POUND of 100 piastres	1·107	·903 (18s. 0¾d.)	1 T. Pound (*G*) = 18s. 0¾d. 1 piastre (*s*) = 2d.
Persia	Silver KHRAN of 20 shahis	21·24	·047 (11¼d. varies)	1 Toman (*G*) of 200 shahis = 9s. 5d. 1 Khran (*s*) of 20 shahis = 8½d. 1 shahi = ½d.
Peru	See South American States.			
Portugal ...	Gold MILREIS (1000 reis)	4·51	·2218 (4s. 5¼d.)	½ Coroa (*G*) of 5 milreis = 22s. 2¼d. 1 milreis (*g*) = 4s. 5¼d. 1 teston (*s*) of 100 reis = 4⅜d. 10 reis (*b*) = about ½d.
Roumania † ...	Same as France.			
Russia ‡ ...	Silver ROUBLE of 100 kopecks	9·49	·1054 (2s. 1¼d.)	10 roubles (*G*) ‡ = 21s. 2d. 1 rouble (*s*) = 3s. 2d. 10 kopecks = 4d. 1 kopeck (*b*) = about ½d.

* The French gold 20-franc piece circulates readily.

† See "The Latin Union," page 103.

‡ The "Imperial," formerly rated at 10 roubles, is now rated at 15; consequently the par value of the rouble is reduced to 2s. 1¼d. See end of "Explanatory Notes." The ½ rouble = 9½d., tallies with the franc of the "Latin Union," which see. The paper currency is now being replaced by silver and bronze coins.

TABLE (*continued*).

Country.	Money of Account	Number of Coins receivable for £1, at par.	Multiplying figs. to convert, at par value, into Pounds Sterling; with result.	Remarks. (*G*) gold coin; (*g*) gold coin also a monetary unit; (*s*) silver; (*n*) nickel; (*b*) bronze. Silver at 60⅞d.
Servia*	Same as France.			
South American States—				
Argentina ...	Silver PESO † of 100 cents	5·05	·198 (3s. 11½d.)	5 pesos (*G*) = 19s. 10d. 1 peso (*s*) = 3s. 11¾d. 10 cents = 4⅞d. 1 cent = ⅝d.
Chili, Columbia, Uruguay	Silver PESO † of 100 cents	5·33	·1875 (3s. 9d.)	5 pesos (*G*) = 18s. 9d. 1 peso (*s*) = 3s. 11¾d. 10 cents = 4⅞d. 1 cent = ⅝d.
Peru	Silver SOL † of 10 dineros or 100 cents	10·00	·10 (2s. 0d.)	1 libra (*G*) = 20s. 0d. 1 sol (*s*) = 3s. 11¾d. 1 dinero = 4⅞d. 1 cent = ½d.
Spain*	Same as France.			
Sweden ...	Same as Norway and Denmark.			
Switzerland* ...	Same as France.			
Turkey	See Ottoman Empire.			
United States, Canada, &c.	Gold DOLLAR of 100 cents	4·87	·2055 (4s. 1¼d.)	⅕ eagle (*G*) or 5-dollar = 20s. 6½d. 1 dollar (*g*) = 4s. 1¼d. 1 dollar (*s*) = 4s. 2⅝d. 10 cents (*s*) = 5d. 1 cent (*b*) = ½d.
Uruguay ...	See South American States.			

* See "The Latin Union," page 103.

† The Peso and Sol are equal in value to the French 5-franc piece (see "Latin Union," page 103). In some States the circulating medium is principally inconvertible Paper Money. The 5-peso piece goes under the varying name of Argentino, Doubloon, Sucre, Piastre, and Venezolano.

THE LATIN UNION.

This Union was originally a "monetary alliance" between Franc Belgium, Italy, and Switzerland, subsequently joined by Greec formed with the object of maintaining a fixed ratio betwee "pure" gold and "pure" silver of $15\frac{1}{2}$ to 1. This would giv "Imperial standard" silver a constant value of $60\frac{7}{8}$d. per troy oz.

Such an arrangement necessitated the free coinage of silver a well as gold, and gave an enhanced value to silver, with the resu that silver poured in from other countries in exchange for gold.

Consequently these Bimetallic Countries, whilst maintaining th ratio in their *coins*, could not keep the ratio of *the "value" of thos coins* constant: the free coinage of silver therefore had to b abandoned to save them from going bankrupt.

However, the countries belonging to the Union still have thei monetary units and subdivisions of the same weight and fineness— and therefore value. All their larger silver coins to-day would b par or face value if the ratio they wished of $15\frac{1}{2}$ to 1 were fixe upon. The monetary unit itself, though, is not of equal finenes with its higher multiples.

Several other countries have since followed this example, but in the case of Finland the markka is made of equal fineness to its higher derivatives. With this small exception, all the denomina tions in the following table are of equal value, though usually differing in name :—

Country.	Monetary Units of Equal Value, but Differing in Name.	Name Given to the "Centesimal" Part of Such Unit.
Belgium	franc	centime
Bulgaria	leva	stotinki
Finland	markka	penni
France	franc	centime
Greece	drachma	lepta
Italy	lira	centesimi
Roumania	ley	bani
Servia	dinar	para
Spain	peseta	centimo
Switzerland	franc	centime

In Austria and Hungary, the krone of 100 hellers is made of equal value to the franc.

In Russia the ½-rouble is equal to the par value of the franc, and the gold "half-imperial" to the gold 20-franc piece, which latter coin circulates readily in Turkey.

In most of the South American States the monetary unit, called the Peso or Sol, is made equal in value to the silver 5-franc piece. And so on.

Thus the Trading between all these countries is encouraged.

What a Ratio of 15½ to 1 Would Mean.

As will be seen by the last column in the table on pages 98 to 102 this basis would give a value of only 11d. to the shilling; 10½d. to the German mark, against a par value of 11¾d.; 8¾d. to the Austrian krone, against 10d.; and so on.

It would bestow a par value, namely, 3s. 11½d., upon the silver 5-franc piece, and its *fac-similes* in other countries, and also upon the Peso and Sol of South America. It would fix the value of the tael of China and the piastre of Indo-China at 6s. 6¼d. and 4s. 2d. respectively, when their melting-up value to-day is less than 3s. 0d. and 2s. 0d.; and the Silver Dollar of the United States would be raised above the present value of the Gold Dollar.

In Russia, Japan, and India (each of which had formerly a silver basis only) the silver coins are large compared with British silver coins nearly related in par value. The par value in these countries would therefore considerably rise, namely, the rouble from 2s. 1¼d. to 3s. 2d., the yen from 2s. 0½d. to 4s. 3¼d., and the rupee from 1s. 4d. to 1s. 10½d., as shown in the table already referred to.

Supporters of the Bimetallic theory have, from time to time, suggested fixing various ratios for gold to bear to silver, and advanced great arguments to uphold the same. They have not found many followers, however, in Great Britain or the Dominions beyond the Seas, all of which are "gold" countries. Every proposed ratio requires studying on its own merits, but when a Bimetallist talks confidentially he will generally say, "Start with what ratio you like, the value of silver would slowly rise under Bimetallism, and there-

fore the ratio could from time to time be adjusted, until it reach 15½ to 1." Let us see how the British Empire would be effected it agreed to this ratio.

No silver coins are now worth their par value, the intrinsic, natura or market value of silver being to-day (1/1/'04) only about 26d. per o To adopt the Latin Union ratio would, therefore, artificially rai every ounce of silver in the Silver Countries to more than "double its present value; or, to put the proposition another way, ever British sovereign, in India and elsewhere, would be reduced i value to about 9s. 0d.*

The Latin Union and Imperial Decimal Coinage.

It has already been shown that the silver coins of many countrie correspond with one another. But a number of those countrie also have gold coins equal, or almost equal, in value to the Britis Sovereign, as is shown in the last column of the table on pages 9 to 102.

The Peru libra and sovereign of British India are exactly equa to it; the Egyptian pound, Japanese 10-yen, United States an Canadian 5-dollar piece, Mexican 5-peso piece, and Indo-Chin 5-piastre piece are all worth a trifle more than the sovereign; an the German 20-marks, Latin-Union 25-franc piece,† and the Argen tino are all worth only a trifle less than our sovereign.

But these countries will not so adjust their gold coinage to agree in value with the British sovereign so long as we retain its awkward subdivisions, and its standard weight '01 below 8 grams (see page 93). On the other hand, the French monetary plan will continue to gain adherents to the detriment of our International relations.

It is not difficult, therefore, to see that by failing to adopt a decimal coinage system, we are heavily handicapping ourselves in the World's Markets, and responsible for the "Coinage-Babel" of that World.

* Apart from all the gold in the British Empire, it must be borne in mind that about 100 millions of pounds sterling are now yearly payable, in *gold*, to people in the United Kingdom, in the way of interest on their capital invested abroad.

† In some of the Union countries there is not a 25-franc piece.

A SUGGESTION FOR IMPERIAL DECIMAL COINAGE

OR

CHANGE IN OUR SYSTEM OF COUNT.

"That in the opinion of this Council the adoption of the Metric System of Weights and Measures and a Decimal System of Coinage of the United Kingdom would greatly promote and benefit the educational, scientific, manufacturing and commercial interests of the country."

Resolution by the Council of the Institute of Chartered Accountants, July 8, 1903.

The whole World, except the United Kingdom and "parts" of the Empire, have adopted decimal coinage (see table page 112), China having done so from time immemorial.

If Great Britain and the Colonies, which have not already a decimal coinage, are to place themselves on an equal commercial footing with the rest of the World, it will be seen the change would not require so much of an amendment of our coinage as it would the introduction of the simplest way of counting it.

Gold Coinage.

To materially alter the value of the pound sterling, not merely a coin, but a standard throughout the World, is too serious to contemplate.*

The gold coinage could therefore remain the same, excepting, perhaps, that the design on one side of the half-sovereign should show it was also equal to five florins.

Silver Coinage of 1s. 0d. and upwards.

This would be reckoned in florins, or tenths of a pound,† instead of in shillings.

* To increase its value less than ¼d., by altering its standard weight from 7·988 grams to exactly 8 grams (its maximum weight is 8·00101) as hinted on page 93, could not be considered a serious alteration, but this idea is immaterial to the proposal for a decimal coinage.

† "One-tenth of a pound" already appears on most florins.

It would not require altering, even in name, for although we now reckon in shillings, all the multiples of a shilling are called by other names, *e.g.*, crown, florin, &c.

But it would be better for the design on one side of the new silver coins to also show the new method of count.

Coins Below the Value of One Shilling.

96 farthings now make 1 florin.

If 100 farthings were coined to the florin instead, we should complete our decimal coinage as follows :—

100 farthings or "mils" * = 1 florin.
10 florins or 1,000 mils = 1 pound.

The sixpence would also remain, but under the entirely new name of ¼ florin or 25 mils, which could be shown in the new design for one side.†

Threepenny pieces (which were never issued before 1861), could be entirely withdrawn from circulation.

Bronze Coins.

The Mint could issue :—

25 new pennies	for every	24	present pennies	handed in.
Or 50 new half-pennies	„ „	48	„ half-pennies	„ „
Or 100 new farthings	„ „	96	„ farthings	„ „

The new bronze coins could be the same size, weight,‡ and design

* Recommendation of the Royal Commission in 1838. The Commission of 1857 advised the delay in the alteration pending the adoption of the Metric System. Another Commission was held in 1868 after the International Conference in Paris in 1867, in reference to a universal currency.

† See design of Queen Anne 6d., 1707 ; similar to florin.

‡ It must be remembered that bronze coins, like silver, are only tokens, the amount of metal in the coins having nothing to do with their actual value. For example, (*a*) if the bronze in 48 pennies to-day were converted into half-pennies there would only be 80 half-pennies = 40 pence ; (*b*) until 1860 copper coins of the same exchange value as at present were made more than "double the weight." Our forefathers witnessed a reform like this with equanimity : the present generation is apt to be too timid.

as the present ones, excepting that the designs on one of their sides would, as on the present florin, show two denominations.

1 penny ; 4 mils.
1 half-penny ; 2 mils.
1 farthing ; 1 mil.

The exchange value of bronze coins would therefore be decreased 4 per cent., an amount many have already depreciated through wear, and infinitesimal compared with the decreased value of the light gold coins, which were allowed to keep in circulation for years (finally withdrawn 1890). It would not be of consequence, therefore, if the present and new bronze coins were in circulation at one and the same time.

No one would object to receiving 25 pennies for 24, or 25 farthings for a ¼ florin. And if the working men, who use bronze coins largely, were able to purchase with the new penny what they now buy with the old penny, they would save 1 farthing or mil in every ¼ florin which they spent in *coppers*. But it is only reasonable to suppose that the retailers would change the quantity supplied *pro rata* so that neither the retailer nor consumer would gain or lose by the change. There are, however, instances in which the quantity or accommodation supplied and the price could not be so easily regulated, such as railway mileage and the daily newspapers. These are matters requiring special consideration and are dealt with on pages 147 to 154.

A Nickel Coin.

It might be deemed advisable afterwards to have a coin representing a value in between the new penny and ¼ florin, namely, a 10-mil piece worth about 2½d. present money.

A 10-mil silver coin might be confused with the old threepenny piece. To avoid this it could be made larger in nickel.*

* Charles II. used tin for coinage, 1684 ; and his successor James, gun-metal and pewter, after his abdication. Nickel coins are largely used on the Continent, being lighter and smaller than their equivalent in bronze.

Summary of Proposed Adjustments.

(*a*) A new design on one side of most of the coins, showing the new system of count, or denomination.
(*b*) The withdrawal of threepenny-pieces.
(*c*) A new coin, if desired, of nickel.
(*d*) An alteration of 4 per cent. in the exchange value of the bronze coins.

A Proclamation.

It may surprise many that these adjustments can be done by Proclamation (see sec. 11 of the Coinage Act of 1870, given *in extenso* in this book, on page 25).

This would not be so in the case of (*d*), were the weight of the bronze coins altered (see sec. 3 of the same Act), but there is nothing in the Act to say that 12 pennies must make one shilling.

All Parliament would have to do, would be to vote a small sum for the extra expenses of the Mint.

To avoid much loss on the bronze coins, one shilling in present coppers could be exchangeable for, say, three 10 mil-pieces, three new pennies, three new half-pennies and two new farthings.

Table of Present Coins Showing the New System of Count.

(The fundamental units are emphasised.)

The present	SOVEREIGN	would still be called a Sovereign.	10 florins.
"	"	Half-sovereign would also be designated	5 florins.
"	"	Crown " " "	2½ florins, or 25 cents.
"	"	Double-florin " " "	20 cents.
"	"	FLORIN " " "	10 cents.*
"	"	Shilling " " "	5 cents.
"	"	Sixpence would change its name to ½ florin,	or 25 mils.
"	"	Penny would also be designated	4 mils.
"	"	Half-penny " " "	2 "
"	"	FARTHING " " "	1 "

The three last coins would have a diminished value of 4 per cent.

* Or "One-tenth of a pound," a description that generally now appears.

Arithmetic of Decimal Coinage.

An immense amount of labour and time would be saved in all sums of addition, subtraction, multiplication, division, and proportion, and our whole arithmetic rendered more accurate.

Conversion into Decimal Amounts—Mentally.

When once the Decimal System had been started we should require no conversion tables, but a rule is here given for conversion on the eve of the transition, of all sums under one pound.*

RULE :—For every 2s. count 1 florin, for every remaining 6d. count 25 mils, and bring any further remainder to farthings and call them mils, adding 1 if the number of farthings is above 12.

Examples :—

0s. 8¾d.	=		(25 + 11) mils	=	36 mils
1s. 4¼d.	=		(50 + 19) „	=	69 „
5s. 9¾d.	=	2 fl.	(75 + 16) „	=	2 fl. 91 „

NOTE :—This rule may now be used for converting all sums under £1 into decimal parts of a pound. For in the above, 36 mils = ·36 florin or ·036 pound. Similarly 5s. 9¾d. = 2·91 fl. or £0·291.

Book-keeping of Decimal Amounts.

Cash columns would be ruled as at present† ; in the florins column there would only be units instead of units and tens, as in the present shillings column, and the *frequent errors of* 10s. *in casting would occur no more.* In the mils column, farthings and half-pence would disappear, but there would still be units and tens as in the present pence column.

---

* The Government would probably distribute cards showing the decimal value of every sum under £1, or in the case of Banks, &c., cards omitting farthings.

† Unless one column were saved by counting in Pounds and Mils only.

Under the present system we have to :—

Add up the farthings, divide by 4 and carry to the pence column.
" pence, " 12 " " shillings "
" shillings, " 20 " " pounds "

Under the Decimal System we could add up £ f. m. columns like an ordinary addition sum, as though there were no ruled columns in between.

Example of Cash Columns.

£	s.	d.		£	f.	m.
4	0	0	=	4	0	00
7	12	0	=	7	6	00
5	6	6	=	5	3	25
9	15	0	=	9	7	50
4	13	6	=	4	6	75
2	2	2¼	=	2	1	9
5	4	3¾	=	5	2	16
6	5	10¼	=	6	2	93
£44	19s.	4¼d.		£44	9f.	68m.

£44 9f. 68m. can as readily be written £44·968 or £44 9f. 6c. 8m

Why we should make the Change.

Apart from being a quicker system, altogether, the Decimal System would have great Commercial benefits; the *money* quotations of our merchants would be readily understood in other countries, exchange of small amounts by travellers and others would be simplified, and international postal and other rates put on a better footing. The unity would be advanced not only of the Empire, but of the World. From the Table on the next page, the fact that other countries use the Decimal System, is apparent from the number of ciphers appearing in the second column, and it will be seen at a glance, how much better it would be for comparison, if all these numbers ending in ciphers were comparable with 1,000 farthings instead o 960.

(*Continued page 114.*)

TABLE OF COMPARISONS AT "PAR" OR "FACE" VALUES* OF THE SMAI DENOMINATIONS† OF ALL COUNTRIES WITH THE PROPOSE IMPERIAL MIL (*p.i.m.*) OR NEW FARTHING ($\frac{1}{1000}$).

Countries.	Multiples of their small denominations‡	Face Values of such Multiples in Proposed Mils or New Farthings = $\frac{1}{1000}$	Result.
Great Britain and parts of Greater Britain	960 farthings or 1,000 *p.i.m.*	1,000	Proposal simplifies all comparisons
Ceylon and Mauritius ...	1,500 cents	1,000	$1\frac{1}{2}$ c. = 1 *p.i.m.*
India and East Africa ...	960 pice (*a*)	1,000	1 ps. assumed at 1 *p.i.m.*
Peru	1,000 cents	1,000	1 c. = 1 *p.i.m.*
Germany	2,000 pfennige	979	2 p.
France, Belgium, Switzerland, Italy, Greece; also Spain, Servia, Bulgaria, Roumania, Russia (see below), and Finland ...	2,500 cents (*b*) sometimes called paras, stotinkis, banis, or penni	992	$2\frac{1}{2}$ c. — may be assumed equivalent to 1 *p.i.m.*
Argentine Rep., Venezuela	500 cents	992	$\frac{1}{2}$ c.
Holland, Java, &c.	1,200 cents (*c*)	992	6 c. may be assumed equivalent to 5 *p.i.m.*
Austria and Hungary ...	2,400 hellers (*d*)	1,000	12 h. = 5 *p.i.m.*
Mexico	500 cents	1,010	$\frac{1}{2}$ c.
Egypt	1,000 millièmes	1,015	1 m.
Japan, Str. Settlements, Hong Kong, and Labuan	1,000 sen or cents (*e*)	1,025	1 c. — worth but an infinitesimal fraction
Canada, Newfoundland, B. Honduras, United States of America ...	500 cents (*f*)	1,027	$\frac{1}{2}$ c. — more than 1 *p.i.m.*
Russia (but see also above)	1,000 kopecks	1,058	1 k.
Norway, Sweden, Denmark	2,000 ore	1,102	20 o.
Portugal	5,000 rels	1,108	50 r. — worth but an infinitesimal fraction
Brazil	10,000 reis	1,123	100 r. — more than 11 *p.i.m.*
China	3,000 cash (*g*)	978	3 c. about = 1 *p.i.m.*
Persia	1,000 shahis (*h*)	1,000	1 s. = 1 *p.i.m.*
Chili, Columbia, Uruguay...	500 cents	937	
Turkey	4,000 paras	900	
	4,444·4 „	1,000	4·4 p. = 1 *p.i.m.*

NOTE.—All footnotes are on the opposite page.

* Thus :—

By the par or face value of the present Farthing is meant £$\frac{1}{960}$.
" " " proposed Mil " $\frac{1}{1000}$.
" " " Egyptian Mil " E. $\frac{1}{1000}$.

But, of course, the legal tender of all small coins is limited, because they only act for the values appearing upon them ; for example, 960 farthings are not in reality worth One Sovereign : they are merely "nominal" proportional parts of the Sovereign.

† Coins are not always made of the lowest "denomination"; for example, the smallest bronze coin in any country may be a 5 cent piece or 3-reis piece ; on the other hand, ½-cent pieces are current in Holland, ½-mil pieces in Egypt, and so on.

‡ The two final noughts or ciphers in this column, show that Great Britain (and parts of Greater Britain) and India, are the only Countries which have not yet adopted the centesimal system of coinage.

§ To bring the figures in this column to Pounds sterling, point off 3 decimal places, and to reduce to shillings, pence, and farthings, multiply by 20, 12 and 4.

Examples : 992 new farthings = £0·992 = 19s. 10d.
1,010 " " = £1·010 = 20s. 2½d.

If the United Kingdom were to adopt the Centesimal subdivision of the Florin, Foreign Countries would most probably slightly alter the fineness or weight of their gold coins, so that the figures in this column would be exactly 1,000, or perhaps in some cases 1,100 or 900. All the coins of every Nation would then be easily comparable, and immense progress would be made in many ways.

(*a*) By Act 22 of 1899, the Indian Mohur is obsolete, and a British sovereign is made legal tender equivalent to 15 rupees, which gives a rate to the rupee of 1s. 4d. A rupee is, therefore, equal to 16 pence or annas, or 64 pice, or 192 pies. A Sovereign = 960 pice, and 1½ rupees = 96 pice. If India has a decimal coinage, it will most probably be by first introducing a 1⅓-rupee piece, and subsequently increasing the number of pice to 1,000 and 100 for the sovereign and 1½-rupee respectively. Or the rupee may be centesimally divided, as in Ceylon.

(*b*) 10,000 cents or 100 francs = £4 or 4,000 p.l.m. less 7½d.

(*c*) The Dutch gold 10-gulden piece = 1,000 cents = 200 pence = 16s. 8d. or 5-6ths £.

(*d*) The Austrian gold 20-krone piece = 2,000 hellers = 200 pence = 16s. 8d. or 5-6ths £.

(*e*) British Order in Council, 1894. A large issue of copper "cash" has been made by the Royal Mint to Hong Kong and China. 1 cash weighs 1 gram : 1,000 = 1 kilogram in weight, 1 dollar in value.

(*f*) If the American gold 5-dollar piece (= 500 cents) had been kept at the same fineness as the British pound sterling, it would be worth £1 0s. 10d. (instead of £1 0s. 6½d.), or 1,000 present farthings. In other words, the Americans adopted the decimal system by raising the value of the pound, instead of decreasing that of the farthing, and called halfpence cents, 1,000 of which are equal to the 10-dollar piece or Eagle : they have since decreased the fineness of their gold.

(*g*) With standard silver at 60⅞d. per oz., or a ratio in pure metal of 15½ to 1.

(*h*) The value of the shahi considerably varies.

TABLE OF COMPARISONS AT "PAR" OR "FACE" VALUES* OF THE SMALL DENOMINATIONS† OF ALL COUNTRIES WITH THE PROPOSED IMPERIAL MIL (*p.i.m.*) OR NEW FARTHING ($\frac{1}{1000}$).

Countries.	Multiples of their small denominations‡	Face Values of such Multiples in Proposed Mils or New Farthings = £$\frac{1}{1000}$	Result.
Great Britain and parts of Greater Britain	960 farthings or 1,000 *p.i.m.*	1,000	Proposal simplifies all comparisons
Ceylon and Mauritius ...	1,500 cents	1,000	1½ c. = 1 *p.i.m.*
India and East Africa ...	960 pice (*a*)	1,000	1 ps. assumed at 1 *p.i.m.*
Peru	1,000 cents	1,000	1 c. = 1 *p.i.m.*
Germany	2,000 pfennige	979	2 p.
France, Belgium, Switzerland, Italy, Greece; also Spain, Servia, Bulgaria, Roumania, Russia (see below), and Finland ...	2,500 cents (*b*) sometimes called paras, stotinkis, banis, or penni	992	2½ c. } may be assumed equivalent to 1 *p.i.m.*
Argentine Rep., Venezuela	500 cents	992	½ c.
Holland, Java, &c.	1,200 cents (*c*)	992	6 c. may be assumed equivalent to 5 *p.i.m.*
Austria and Hungary ...	2,400 hellers (*d*)	1,000	12 h. = 5 *p.i.m.*
Mexico	500 cents	1,010	½ c.
Egypt	1,000 milliémes	1,015	1 m. } worth but an infinitesimal fraction
Japan, Str. Settlements, Hong Kong, and Labuan	1,000 sen or cents (*e*)	1,025	1 c. }
Canada, Newfoundland, B. Honduras, United States of America ...	500 cents (*f*)	1,027	½ c. } more than 1 *p.i.m.*
Russia (but see also above)	1,000 kopecks	1,058	1 k. }
Norway, Sweden, Denmark	2,000 ore	1,102	20 o. } worth but an infinitesimal fraction
Portugal	5,000 reis	1,108	50 r. }
Brazil	10,000 reis	1,123	100 r. } more than 11 *p.i.m.*
China	3,000 cash (*g*)	978	3 c. about = 1 *p.i.m.*
Persia	1,000 shahis (*h*)	1,000	1 s. = 1 *p.i.m.*
Chili, Columbia, Uruguay...	500 cents	937	
Turkey	4,000 paras	900	
	4,444·4 „	1,000	4·4 p. = 1 *p.i.m.*

NOTE.—All footnotes are on the opposite page.

* Thus :—

By the par or face value of the present Farthing is meant £$\frac{1}{960}$.
" " " proposed Mil " £$\frac{1}{1000}$.
" " " Egyptian Mil " E. £$\frac{1}{1000}$.

But, of course, the legal tender of all small coins is limited, because they only act for the values appearing upon them ; for example, 960 farthings are not in reality worth One Sovereign ; they are merely "nominal" proportional parts of the Sovereign.

† Coins are not always made of the lowest "denomination"; for example, the smallest bronze coin in any country may be a 5 cent piece or 3-reis piece ; on the other hand, ½-cent pieces are current in Holland, ¼-mil pieces in Egypt, and so on.

‡ The two final noughts or ciphers in this column, show that Great Britain (and parts of Greater Britain) and India, are the only Countries which have not yet adopted the centesimal system of coinage.

§ To bring the figures in this column to Pounds sterling, point off 3 decimal places, and to reduce to shillings, pence, and farthings, multiply by 20, 12 and 4.

Examples : 992 new farthings = £0·992 = 19s. 10d.
1,010 " " = £1·010 = 20s. 2½d.

If the United Kingdom were to adopt the Centesimal subdivision of the Florin, Foreign Countries would most probably slightly alter the fineness or weight of their gold coins, so that the figures in this column would be exactly 1,000, or perhaps in some cases 1,100 or 900. All the coins of every Nation would then be easily comparable, and immense progress would be made in many ways.

(*a*) By Act 22 of 1809, the Indian Mohur is obsolete, and a British sovereign is made legal tender equivalent to 15 rupees, which gives a rate to the rupee of 1s. 4d. A rupee is, therefore, equal to 16 pence or annas, or 64 pice, or 192 pies. A Sovereign = 960 pice, and 12½ rupees = 96 pice. If India has a decimal coinage, it will most probably be by first introducing a 12½-rupee piece, and subsequently increasing the number of pice to 1,000 and 100 for the sovereign and 12½-rupee respectively. Or the rupee may be centesimally divided, as in Ceylon.

(*b*) 10,000 cents or 100 francs = £4 or 4,000 p.i.m. less 7½d.

(*c*) The Dutch gold 10-gulden piece = 1,000 cents = 200 pence = 16s. 8d. or 5-6ths £.

(*d*) The Austrian gold 20-krone piece = 2,000 hellers = 200 pence = 16s. 8d. or 5-6ths £.

(*e*) British Order in Council, 1894. A large issue of copper "cash" has been made by the Royal Mint to Hong Kong and China. 1 cash weighs 1 gram : 1,000 = 1 kilogram in weight, 1 dollar in value.

(*f*) If the American gold 5-dollar piece (= 500 cents) had been kept at the same fineness as the British pound sterling, it would be worth £1 0s. 10d. (instead of £1 0s. 6½d.), or 1,000 present farthings. In other words, the Americans adopted the decimal system by raising the value of the pound, instead of decreasing that of the farthing, and called halfpence cents, 1,000 of which are equal to the 10-dollar piece or Eagle : they have since decreased the fineness of their gold.

(*g*) With standard silver at 60$\frac{7}{9}$d. per oz., or a ratio in pure metal of 15$\frac{5}{8}$ to 1.

(*h*) The value of the shahi considerably varies.

Why we should make the change (*continued from page* 111) :—

The probabilities are, too, that many countries would mint coins of equal weight and fineness, and therefore of equal value, to ours (especially if our coins had an inter-relationship, when possible, with Metric Weights and Measures), in the same way as they are adopting Greenwich Time and Meridian of Longitude, and have already adopted the French Metric System. For it must be remembered that many countries would not notice the coinage change like we should, as much of their coinage and paper currency is continually fluctuating in value.

A few people will say, "we shall always be making mistakes," but with the new denominations on the coins to look at, instead of only reading about, we should become used to the new plan of counting "in a few minutes," and wonder why we did not follow the decimal example of all the other nations earlier.

If We Do Not!!

If we delay the change many more years all other countries will eventually adopt French denominations, and we shall be more insulated than ever. Eleven countries have already thus altered, or are now altering their coinage (see "The Latin Union," page 103), and many more are altering their coinage in part.

See also "Combined Effects of Decimalising," page 147 *et seq.; and "Dispute as to Decimal Coinage," page* 156.

GENERAL NOTES ON WEIGHTS, MEASURES, STANDARDS, AND A RADIX.

WHAT IS MEANT BY A SERIES.

It is not generally realised that in the same way as 1s. 7d. must be made up of at least 3 coins, because there is not a coin of that amount, so must certain quantities be made up by using several weights or measures.

That is to say, to make up 29 lbs. we must use a 28 lb. and 1 lb. weights (or 25 lb. and 4 lb. in some Colonies), a 29 lb. weight being "illegal." In the United Kingdom, under the binary system, a 3 lb. weight is illegal, and so on.

Our system being disproportionate throughout, the series of sub-standards or legal denominations vary. Thus, the only multiples of the avoir. pound allowed for weights used in trade are :—

In the United Kingdom, Australia, &c. :

56, 28, 14, 7, 4, 2, and 1. Also 100 and 50.

In Canada, South Africa, &c. :

100, 50, 25, 15, 10, 5, 4, 3, 2, and 1.*

In Decimal Troy weights our series is **5, 4, 3, 2, 1.** In a decimal system, however, a series of only four denominations is absolutely necessary, such as **7, 4, 2, 1 ; 6, 3, 2, 1,** or **5, 2, 2, 1.** Probably the best series is the second here given,† for it is waste of metal and inconvenient if any two denominations of a series together exceed 10, and certainly not more than 2 weights should be required to weigh, say, 8 lbs. It is the series adopted for Native Indian Weights and Measures. (Footnote page 37.)

The present series adopted for our Metric denominations is 5, 2, 2, 1, the duplicate of the 2 being to obtain the number 10. There is no reason why the sum of the denominations should be 10. This series has undoubtedly retarded the adoption of the Metric System in the United Kingdom, as 3 denominations are often required to make up numbers below 10. We may note, in passing, that the pattern adopted for the small brass weights has not enhanced the reputation of the Metric System either, and the fact that denominations cannot usually be verified locally has handicapped the system still further.

The Importance of a Series.

All weights and measures in the British Isles must be verified and stamped once in each year. A series of 4, instead of 5 or upwards, therefore makes a vast difference in the labour incurred.

INTERNATIONAL AND BRITISH DENOMINATIONS.

Apart from the number of weights and measures to be examined, the simplicity or complexity of the denominations is of considerable

* See footnote page 70.

† This is on the supposition that the present weights and measures are replaced at the expense of the Government, the owner having the option of having denominations of 5 and 4, instead of the 6, by paying the extra cost.

importance. Under our ordinary system there are approximately **200** different Board of Trade denominations or sub-standards.

The Metric System requires under one-third the number.

There are about 1,100 Inspectors of weights and measures in the United Kingdom, and the Incorporated Society of Inspectors of Weights and Measures* is an important administrative body in favour of the thorough introduction of the Metric System in place of the present chaos.

INTERNATIONAL AND BRITISH STANDARDS.

Temperatures, &c., of the Metals.

International:—

The prototype meter and kilogram are in the keeping of an "International" Committee or Scientific Society (Bureau International des Poids et Mesures), with a Metric Bureau at Sévres.

This Society is the outcome of a Metric Convention subscribed to by 20 States in 1875, Great Britain not joining until 1884, since when she has contributed her quota to the maintenance of the Bureau. Other countries have since given their support to the Bureau.

One of the Committee's objects is to insure the accuracy of all metric standards throughout the World, the meters being proved with the International prototype within a 5-millionth part, and the kilogram within a 100-millionth part. Should the prototype be lost, they can therefore be restored from International copies existing in any one of the countries which are party to the Convention. Copies were delivered to Great Britain in 1889 and 1894.

The prototypes and International copies of both the meter and the kilogram are all made of 90 per cent. of platinum and 10 per cent. of iridium, an alloy practically non-oxidizable, little affected by heat, and particularly suitable for several other reasons.

The prototype meter is standard at 0° Cent., and the copies as near that temperature as scientific labour can attain. The standard

* Admission by examination. (See Examp'e Papers, "Examination of Inspectors of Weights and Measures," issued by the Board of Trade, 1d.)

kilogram has its true mass in vacuo at 0° Cent. Copies of the Metric standards exist in all the Colonies.

For International Symbols see pages 138 to 143.

British :—

The prototype Imperial Yard is of bronze or gun-metal, marked "Copper 16 oz., tin 2½, zinc 1." It is standard, *i.e.*, true or legal length at 62° Fahr. Copy standards are true at approximately 62° Fahr.*

According to the International Committee 62° Fahr. is equal to 16°·667 Cent., and therefore to compare the prototype yard with the prototype meter the former must be taken at 16°·667 Cent., and the latter at 0° Cent., a somewhat awkward operation.

The gallon measure contains its true weight of water at 62° Fahr., and the gas unit, or cubic foot, is also standard at 62° Fahr. For the standard temperature used by Pharmacists for their Anglo-metrical denominations, see p. 81.

Our Electrical standards are referred to Centigrade scale.

Indian standards are true at 85° Fahr.

The standard pound has its true mass in vacuo at 0° Cent.

NOTE.—The weight or mass of the pound or kilogram depends on the force of gravity, and therefore varies with the latitude. See p. 215, "The Earth's diameters." †

For metals used for copies of standards of weights see Sec. 30, 1878 Act. For standard coin-weights see page 26.

THE IMPORTANCE OF A RADIX
OR Base of a System of Counting.

The **Binary** (Latin, *bini*, two by two) opponents of a Decimal System of Weights and Measures, advocate a system of continued subdivision and multiplication by two's, for which 8 is the convenient basis.

* Parliamentary Paper 334, issued as this book is in the press (Dec., 1903), states the length of the Imperial yard has now been marked on the iridio-platinum bar obtained by the Board of Trade in 1897.

† The variation is immaterial for commercial purposes, and, as it does not affect the comparison of weights in one place, the only weighing machines which indicate a variation in different latitudes are delicate spring balances. For information on Standards, Weighing Instruments, &c., the student is referred to Roberts's "Handbook of Weights and Measures"; "Model Regulations of the Board of Trade"; "General Regulations under the Weights and Measures Acts (London County Council)," &c.

Thus : 2, 4, 8, 16, 32, &c. And $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, $\frac{1}{16}$, $\frac{1}{32}$, $\frac{1}{64}$, $\frac{1}{128}$, &c.

The system is well illustrated in the following examples :—

Measures of Capacity : — Three distinct denominations called Quartern, Quart, and Quarter (page 60).

Avoir. Weight :—$27\frac{11}{32}$ grains equal 1 dram (page 68) and $\frac{1}{64}$ of a diamond carat.

The Inch in which the minute fractions become so complicated, that mechanics, instead of referring to them, speak of "full or scant measure," "a shade smaller," "a tight fit," &c.

The Compass, the binary divisions of which gave us 128 quarter-points of 2° 48′ 45″ (page 178), against the modern style of dividing the circle into divisions of ten as originally done by the Babylonians (page 169).

The **Duodecimal** opponents of the decimal Metric System advocate a radix of 12 because it is divisible by 3. They would not have England adopt a decimal system, but wait until mankind adopted a radix of 12, that is to say, had twelve different symbols for the units instead of ten, with new names in every language for the new figures and their combinations. They expect other countries would then adopt a brand-new British system, forgetting that all existing Empires will have passed away before man has learnt a new system of figures and counting. They are neither practical nor experienced, but, by the deadweight of their negative qualities, have hitherto blocked the path of progress, for which purpose they have combined with the Binarists and "Stop-where-you-are's" against the Decimalists, who are daily gaining ground.

The upholders of the **Decimal** System believe in a decimal system of weights and measures, because all mankind has reckoned in tens, since man adopted the natural radix of 10 because he had 10 fingers.

They adhere to the Metric decimal system of weights and measures, in preference to a decimal system of our own, because those weights and measures are used by nearly all other civilised nations and many uncivilised peoples ; and because there is an inter-relationship between all the measures and weights.

It should be especially noted that the Metric system does not prevent subdivision into halves, quarters, and eights, and the Author recommends Board of Trade standards for subdivisions into eighths of the Metric primary units for certain trades.

Other Radices have been suggested, such as 16, 15, &c., which we need not consider. Suffice it to say, no radix can possibly admit of all numbers below it being evenly divided into it, and only radices of 4, 9, and 16 have their square roots in whole numbers.

A Comparison of the radices of 8, 12, and 10, shows a decided superiority of the 10.

Thus, in a radix of 8, we can say the numbers 3, 5, and 7 do not conveniently compare; *i.e.*, 37 per cent. of the figures. In a radix of 12, the 5, 7, 10, and 11, do not conveniently compare, *i.e.*, 33 per cent. of the figures. In a radix of 10, the 3, 7, and 9 do not conveniently compare, *i.e.*, only 30 per cent.; and our symbols or figures, and system of counting do not require tampering with, and every denomination can be written decimally.

THE INTERNATIONAL METRIC SYSTEM.

RESOLUTION AT THE COLONIAL CONFERENCE.

> "That it is advisable to adopt the Metric System of Weights and Measures for use within the Empire, and the Prime Ministers urge the Governments represented at this Conference to give consideration to the question of its early adoption."

Mr. Chamberlain, "fully recognising the importance of this matter to the Empire," was in correspondence with the Colonial Governments and the Board of Trade upon the subject of the above resolution, before leaving the Colonial Office. What the Colonial Governments have done, is referred to in the Introduction on page 14.

Explanatory Notes on the System.

The *Meter* (pronounced as in gas-meter, from Greek *metron*, a measure) is the fundamental unit from which all the principal Weights and Measures of the World are derived. It is theoretically the ten-millionth part of the Arc of the Meridian, extending from the Equator to the Pole, and is sufficiently near that value to be very convenient in calculations relating to terrestrial distances and areas.

From the Meter were derived the *Liter** (the capacity of 1 c. decimeter of water under standard conditions), and the *Gram* (the weight of 1 c. centimeter of water under standard conditions) †: also Square and Cubic Measures, and in the case of the former, special names were given the "Land" quantities. Thus 100 square meters of land are called an *Ar* (from Area).

The gradations of the Meter, Liter and Gram move in tens. Superficial Measures move in hundreds, and in Cubical Measures, the progression is in thousands.‡

---

* Pronounced "Leeter."

† For all purposes, except where the most exceedingly accurate scientific calculations are required, the Liter and Gram may be considered to bear the relationship to the Meter above given. As a matter of fact, however, scientists deem it impossible to construct with absolute scientific accuracy, small cubes with inside measurements of exact standard measure. Neither can a volume of distilled water be weighed with positive certainty at 4° Cent. in a vessel at 0° Cent. in a vacuum. Consequently in 1875, the International Committee of Weights and Measures, defined the *Unity of Weight* as "a piece of metal of agreed volume and dimensions known as a KILOGRAM," and the *Unit Measure of Capacity* as "the volume of a KILOGRAM of water under standard conditions."

The diagram on the next page, therefore, concisely explains the practical relations of the measures of extension, weight, and capacity as now fixed Internationally.

‡ Thus a decimeter being $\frac{1}{10}$ of a meter, a square decimeter is $\frac{1}{100}$ of a square meter, *i.e.* $\frac{1}{10} \times \frac{1}{10}$. And similarly, a centimeter being $\frac{1}{10}$ of a decimeter, a cubic centimeter is $\frac{1}{1000}$ of a cubic decimeter, *i.e.* $\frac{1}{10} \times \frac{1}{10} \times \frac{1}{10}$, = one millionth of a cubic meter. To understand any square or cubic measures, one should bear in mind the difference in meaning of expressions like "4 square centimeters" and "4 centimeters square": the former area would denote a square 2 centimeters by 2 centimeters = 4 square centimeters; the latter would be a square of which one side was 4 centimeters = 16 square centimeters. Thus in Land measurements a deciar denotes a square figure with an area 10 square meters, and with a side $\sqrt{10} = 3{\cdot}162$ meters. But 10 meters squared would represent a square containing 100 square meters, *i.e.*, 1 ar. Similarly with cubes: a cube with a side 10 meters would have a capacity of 1,000 cu. meters, whereas a cube containing but 10 cu. meters would have a side equal to $3\sqrt{10} = 2{\cdot}154$ meters. It is clear, therefore, that in reference to square and cubic measures, it is more convenient to only use the ascending or descending grades of 100 and 1,000 respectively.

Consequently in Square Measures, two figures belong to each denomination, and in Cubic Measures, 3 figures. When reducing from one denomination to another, care must be taken to move the decimal point accordingly, and to insert or add ciphers where necessary, so as to keep the place-values of the figures correctly. Thus an area of 1 sq meter 1 sq. decimeter = 1·01 sq. meters or 101 sq. decimeters; and a volume of 4 cu. meters 3 cu. decimeters = 4·003 cu. meters or 4003 cu. decimeters. In the present British Chain and Link for Land measures the operation is similar.

Subdivisions are denoted by Latin prefixes, and Multiples by Greek prefixes. These and their meanings are as follows :—

Latin Subdivisions.		Greek Multiples	
Milli	$\frac{1}{1000}$th or ·001	Deka	10
Centi	$\frac{1}{100}$th or ·01	Hekto	100
Deci	$\frac{1}{10}$th or ·1	Kilo	1,000
		Myria	10,000

It will be noticed that the prefixes for the small denominations are soft sounding (*c*), and for the larger denominations hard sounding (*k*). It is seldom, though, that all the prefixes are used, it being customary to express most quantities in terms of one or two units only, and decimal parts thereof. Thus 4 meters, 1 decimeter, 2 centimeters, and 3 millimeters would be expressed—

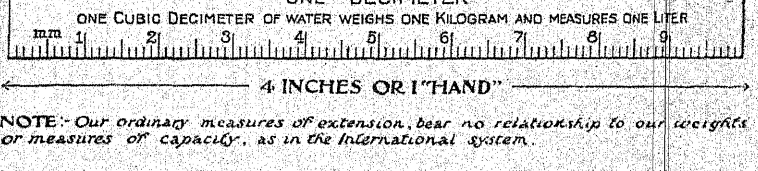
4·123 meters, or to avoid using a decimal point 4 m. 123.

Or if it is desired to show the quantity in centimeters, it is done by simply altering the position of the decimal point—

412·3 centimeters, or to avoid using a decimal point 412 cm. 3.

The Metric Tables only appear formidable when tables of comparison with British Measures are given, carried out to several places of decimals. As this book is intended to be a work of reference for many purposes, these tables of comparison, scientifically accurate, are shown on pages 138 to 144 but no one must be led to think that any conversion tables would be required in the ordinary every day matters of life. **All that is necessary is printed at the very commencement of this book.**

To enable us to distinguish and appreciate the connection of the whole Metric System, and the relative dependency of its several parts, we should learn to thoroughly understand this diagram, which is to scale and is amplified in the tables overleaf :—



NOTE:—*Our ordinary measures of extension, bear no relationship to our weights or measures of capacity, as in the International system.*

The Practical Relations of the Metric Measures of Extension, Capacity, and Weight.

(1) *In multiples of* 1,000 = 10^3

1 cu. centimeter = 1 milliliter
1 cu. decimeter = 1 liter
1 cu. meter = 1 kiloliter

(2) *In multiples of* 1,000 = 10^3

1 cu. millimeter of water weighs 1 milligram
1 cu. centimeter „ „ „ 1 gram
1 cu. decimeter „ „ „ 1 kilogram
1 cu. meter „ „ „ 1 tonne

(3) *For Land. In multiples of* 100 = 10^2

1 sq. meter is called 1 centiar
1 sq. dekameter = 100 sq. meters „ „ 1 ar
1 sq. hektometer = 10,000 „ „ „ „ 1 hektar

Thus if we refer to water we see :

A cubic decimeter
A liter measure
A kilogram weight
} *are the same quantity.*

Likewise :—

A cubic meter
A kiloliter measure
A ton weight
} *are the same quantity.*

And so on.

Advantages of the System.

There are fewer derived standards, and all of them are in a decimal scale. The system can, therefore, be learnt in a few hours.

It annihilates the difficulties of Arithmetic, so that many calculations can be made as fast as we can write, with less fear of errors.

Its essential quality of correspondence between the measures of length, surface, volume, weight, and capacity, as shown in the foregoing tables, makes it far more easily understood and used, and more widely known, than the worrying British Weights and Measures, although the latter have been much longer established. Even semi-civilised peoples have easily adopted it, and when introduced into England for certain purposes only, no explanation of the system was required in the Act.

The more we use it, the more we shall like it and grasp its superiority. Among other things, we shall learn to appreciate the advantages of such labour-saving appliances as the Slide-rule and Calculating Machines.

The system is used by 500 millions of our Foreign customers, and it is, therefore, the only one which facilitates inter-commerce and enables a universal system of standardising. Thus, machines made in England, may be rendered useless abroad, by breakages, unless made repairable there with standardised fittings.

Countries which have Adopted it

(or are contemplating doing so, as shown by footnotes).

Being so easily understood, it has commanded the approval of the Civilised World, and, although some of the denominations may be called by different names, it has been adopted in the following Countries, their Colonies, Islands, &c.

Europe:—All Countries, "except the United Kingdom."*

North America, &c.:—United States †, Canada ‡, Greenland, Mexico, the Central Americas, Cuba, San Domingo, Hayti, and other West Indian Islands "not British."

South America:—All countries "except British Guiana."

Asia:—Japan, Philippines, and East Indies, "except British." (The Indian W. and M. Act, 1871 [metric system] is in abeyance until Great Britain adopts the system as the only legal one.)

* Denmark and Turkey are in the transition stage. Russia adopted it in 1894, but up to the present has waited, before making it general, until Great Britain does so.

† Authorised in 1866, but not yet general, the old Winchester measures also prevailing. But a Bill will be presented to Congress next Session.

‡ See sections 23, 35, and Schedule 3 of Chap. 104, 1886.

Africa:—Egypt,* the Colonies, Protectorates, &c., of European nations, "except British Dominions, &c." †

The One Country and Empire (Our Own) which Hesitates.

The Historical Outline of our Weights and Measures given in the Introduction, points out that a change in our denominations would by no means be without parallels within recent years. It was also demonstrated that events for a long time have tended to make the adoption of the Metric System probably easier of accomplishment in the British Isles than in any other country.

The reform, too, has been more needful to manufacturing England than to any other country. Her complicated standards and derived standards (such as the units of power, pressure, specific gravity, &c.) have choked her factories until they have announced they cannot execute all the orders. Other nations, adopting quicker, more accurate and simpler "International" methods, have, therefore, diverted and are continually diverting much of the trade of which England thirty years ago held almost the monopoly, as is evidenced by Consular Reports from all quarters of the Globe. In France, for example, imports from metric using countries have increased to the detriment of the Anglo-Saxon countries.‡

In 1901, the Prince of Wales, when entertained by the City which is the hub of the Empire, warned England, in his speech, that she must—Wake up!!!

Yet, among other things, the Mother Country still hesitates to adopt the International Metric System in a practical form, until finally the Dominions beyond the Seas, who have so far waited for England to make the adjustment, have petitioned her to adopt the system, the last petition coming from the Houses of Parliament of the Cape Colony a few months ago. But in England we are all waiting for one another as though paralysed.

---

* Adopted in Customs Department, 1893.

† The Metric System is authorised in Barotseland (see page 34), and a Kilogram standard has been supplied to the Soudan.

‡ See "Proposed Adoption of the Metric System by the United States" (American Chamber of Commerce, Paris, Bulletin No. 23, Answer 22).

To avoid laying down a duplicate set of machinery for the home and foreign markets, many manufacturers have waited for a demand for goods in metric quantities to come from the Retailers.

The Retail Trader who would prefer the quicker decimal system cannot afford to play with his business and adopt the metric system, if all his competitors in the same town and district do not make the change with him. He is, therefore, waiting for the Wholesale Trader to alter.

The Consumer is not individually concerned except indirectly, because he has a vested interest in the country which shows signs of losing its vitality, *i.e.*, adaptability. He is therefore only concerned as a voter, and unless a general or compulsory measure is passed, must wait until the question is put before the country. *But it is a non-party question!*

The Schoolmaster is waiting to discontinue teaching the British weights and measures until he is sure the Metric System will be universally adopted before his pupils enter upon their commercial careers. And so on.

Whilst therefore the mass of intelligent people and the throbbing hives of industry in the North, are waiting for a compulsory measure to make the system general, about one-half of the Members of the Imperial Parliament, of all shades of politics, are withholding a compulsory measure "until the system is adopted."

This position reminds one of the old ditty:—

> Said Chatham, with his sword half drawn,
> I'm waiting for Sir Richard Strachan;
> Said Strachan, I'm longing to be at 'em,
> But I'm waiting for the Earl of Chatham.

The Empire which hesitates is lost!

Why Our Country should Hesitate no Longer.

A compulsory Act is but the last step of many which will bring us into the ranks of the other nations, and should be taken at once.

The same amount of internal trade will be done as formerly, but the volume of our foreign trade would be materially increased.

The permissive Act of 1897 enables all foreign countries to send their products through our Customs Houses without trouble.

Whereas, so long as we continue to export goods in ordinary Imperial denominations, they must enter other countries "subject to fines," in the form of extra duty: for we cannot expect foreign Customs Houses to have a special tariff of charges made to fit our requirements. Neither can we expect our foreign customers to buy goods 10 per cent. smaller than others in their country or to learn our awkward trade language, although the foreign competitors for our Home and Colonial Trade will wherever necessary. Further, Dock Companies often ignore odd qrs. and lbs. on Shipping Notes which Continental customers take as official, and therefore refuse to pay by Invoice. Whereas all metric terms can be expressed in one denomination.

Over one-half of the Food Supplies sent to the British Isles arrives in Metric quantities. For the purposes of statistics and retailing it must be converted into ordinary Imperial quantities. This all adds to the cost of living.

How We Waste.

Lord Rosebery, referring to such matters, has said, "We are a people of enormous waste. We waste simply by not pursuing scientific methods."

Our Town and Parish Ordnance Maps, prepared at great expense to the country, are plotted to what are really simple International Metric scale, yet no Metric scale is shown upon them. A metrician knows, by rapid thought, rather than calculation, that if there have been 25 millimeters of rainfall, 250 kiloliters or tonnes have fallen to the hektar (his figures are $100 \times 100 \times \cdot025$). But it requires something more than mental arithmetic to find that one inch of rainfall means about 22,624 gals., or 101 long tons, or 113 short tons to the acre. And fresh calculations would be required to find the quantity fallen on one morgen, arpent, or bigah.

The Drapery Trade forms another striking example of time wasted. Drapers now buy much of their material in folds of a meter or fractions of a meter: the invoices are made out in yards, and must therefore be checked by measuring off the material in yards or left unchecked. It is also measured off in yards when sold or at stocktaking, which measuring would be unnecessary if the

metric system were adopted, for folded in with the material from Parisian houses is generally a narrow strip of paper marked off in meters. The Parisian, too, with his keen eye to natural failings, sends his price lists into England, upon which he points out that the meter is longer than the yard.

In the schools, too, time which could be spent in mastering other subjects is devoted to struggling with our ordinary weights and measures, which convey but little meaning to the pupils' minds. It has been estimated a British child must be kept one year longer at school than the average European child, and then leave school less prepared for the battle of life.

Proof that our present vexatious system does not meet the wants of the day has been recently (Oct., 1903) demonstrated in the *Daily Telegraph* by letters appearing under "Sham Education." A Shipping Merchant tried to select two lads from a number of lads "over 14 years of age," and as a test of merit asked them "What would 5 tons 11 cwt. 3 qrs. 23 lbs. cost at £5 11s. 6d. per ton?" (Answer, £31 4s. 1¾d.) Not one of the lads was able to give the correct answer. But if we had had the decimal system, the question would have been "What would 5·5977 tons cost at £5·575?" This is a simple multiplication sum.

Some shallow thinkers will exclaim, "But how our race will deteriorate without mental gymnastics!" The answer to such is simple. If the lads' brains had not been destroyed with our grotesque methods, they would have had time to learn higher mathematics and the advantage of "powers of ten." The smartest boy would have answered "I can do it quicker by logarithms, if you have a book in the office."

These would have been his figures :—

log.	5·5977	=	0·7480096
,,	5·575	=	0·7462449
,,	31·207	=	1·4942545

Answer £31·207 (or £31 : 2 florins : 7 farthings), and the Shipping Merchant would have checked the answer by turning the handle of a calculating machine.

ompare this with the present method :—

:wt. = ½ of 1 ton ...	£5 11s. 6d.	...	price of 1 ton.
	5		
	27 17s. 6d.	...	price of 5 tons.
:wt. = 1-10 of 10 cwt.	2 15s. 9d.	...	price of 10 cwt.
;r. = ¼ of 1 cwt. ...	0 5s. 6 9-10d.	...	price of 1 cwt.
;r. = ⅛ of 2 qr. ...	0 2s. 9 9-20d.	...	price of 2 qr.
lb. = ½ of 1 qr. ...	0 1s. 4 29-40d.	...	price of 1 qr.
lb. = ½ of 14 lb. ...	0 0s. 8 29-80d.	...	price of 14 lb.
lb. = 1-7 of 14 lb. ...	0 0s. 4 29-160d.	...	price of 7 lb.
	0 0s. 1 109-560d.		price of 2 lb.
	£31 4s. 1 911-1120d.		price of 5 tons. 11 cwt. 3 qr. 23 lb.

loss of 73 figures, 44 words, &c., besides time and money, and in fatigue. No wonder foreign competition pinches.

A Little Progress.

All Scientists, Customs House Officers, and Importers from the tric Countries must necessarily be well acquainted with the ernational Metric System. It has been adopted by the Mint for tain Over-sea coinage, by Electricians, by several firms building ips, Bridges, &c., Gun Factories, in the Yarn Trades, in Phar- cy, by Opticians, Watchmakers (Swiss millimeter screws and ings), in several London Restaurants,* &c. Employees of some the Colonial Railways and other Public Works are now required have a good knowledge of it before employment is given them, d so on. It is also used in Athletic Sports and Games, in up-to- e schools.† But the "Roll of Honour" must necessarily be ded to very slowly so long as the system is held back in so many ys. The Railway Companies, for example, are practically barred m using it by statute,‡ although if an Act permitted them to use a unifying process for the whole country would set in.

Also see "Reputed Pints and Quarts," page 66.
Clyde House School, Hereford, is believed to have been the first to set the mple.
‡ See page 148.

Further, it could be enacted that all Metric Weights and Measures should be assized without fee, and extra be charged for assizing non-metric weights. And as the transition days approached, cards, on which were printed the practical Metric and ordinary Imperial equivalents, could be distributed in all places of business at National expense.

The various Governments could even manufacture metric weights and measures, in the same way as coins are made by the Mint. It is no excuse, therefore, to say private enterprise could not meet the sudden demand for Metric denominations.

There is nothing to prevent the County Councils from marking out the roads in kilometers, not necessarily with monumental stones like the present milestones, but small posts coloured and lettered, after the method laid down in section 10 of the Motor Car Act for every sharp corner, dangerous hill, &c. Apart from the direct usefulness of so doing, it would have the advantage of helping to educate every one in the long distances of the Metric System in a practical way. It may appear a large item to do this from Land's End to John o' Groat's House, but after all it is only a small affair when we remember it has been done in territories stretching from Madrid to Port Arthur. There are two quick, cheap and easy methods for doing this. One by a road measuring wheel or viameter, taken along the middle of the road, the other by scaling off the Ordnance Maps. The former method gives "sloping" distance, and the second the horizontal or flat distance.

Sports Grounds can be marked out in Metric Measures. Jockeys can be weighed by Metric Weight, and so on. In short, it rests with every profession and trade, and even *every individual*, from the King downwards to take their share in bringing about this urgent reform, for the importance of the "waking up" can only be gauged when we realise that if our Continental rivals continue the rapid progress made in the last 30 years, and the British were to neglect the matter for say another 25 or 50 years, the Empire would probably sink into a second-rate Power through further loss of commerce, never to be recovered; for "Water which has once passed the mill will never grind the corn."

Organisation Required.

If the new Weights and Measures are to be supplied at Government expense, the transition period would require cutting up in

sections, so that the work could be done steadily Trade by Trade, and perhaps County by County. The necessity of two sets of weights on the shop counter at the same time would be thus avoided, and the old ones could be destroyed.

Thus the date fixed for the International Measures being the only legal ones in the Liquor Trade could be a different one to that fixed in the Corn Trade. Goldsmiths and Apothecaries would have a period to themselves, Drapers to themselves and so on. The dreaded transition "period" resolves itself, therefore, into several transition "days."

The Press are Helping.

Metric measures which are given in cables from foreign countries are not now so often converted into ordinary Imperial denominations, especially in the leading papers. Since the advent of the motor, distances are given in kilometers. At the time of the volcanic disturbances in St. Pierre, the weight and height of ejected matter were given in Metric terms. And so on. Discussions on the subject in the Daily and Weekly Papers would forward the movement immensely.

Metric Exhibitions.

An Exhibition in London would also help, where the buildings and gardens were planned in Metric quantities, commodities sold in Metric terms, carpenters working with 4-fold meters like the 4-fold yard (and not the cheap foreign-made "un-stamped" *four-feet* Metric measures now appearing in England), drapers with meters marked off in eighths, beverages in metric glasses, and so on. But the full benefits of a change could not be realised without decimal coinage. An interesting feature in such an Exhibition would therefore be the coins of all nations, showing their relations to the Sovereign and Farthing, as in the specially prepared tables in this book.

Provincial Exhibitions in the Shire and Town Halls in the Provinces could also be held.

How We "Cannot" Adopt It.

Many British advocates of the system have courted failure in the past, by trying to compulsorily introduce with the system its "nomenclature" *en bloc*, and some even insist on foreign pronunciation and spelling.

The author maintains, however, that if the system is to "catch on" with the British people, it is no use telling them that in future they *must* buy their goods by the *metre*, *gramme*, *and decalitre. That is the wrong way of putting it.*

How We "Can" Adopt It.

We should endeavour to bring the common weights and measures of every day life into line with the metric weights and measures, and on all our adjusted measures stamp the familiar names, prefixed by the word "metric," alongside the metric value. Thus :—

1 metric pound	1 bi-pound
½ kilogram	1 kilogram.

In this way Germany, Holland, and other countries adjusted their existing standards to the metric standards, and avoided French names. Thus in Germany the meter was called the *stab*, the centimeter became the *new zoll*, the millimeter the *strich*, the liter the *kanne*, the half-liter the *schoppen*, and half-kilo the *pfund*.

In the Indian Weights and Measures Act of 1871, the kilogram and liter were both called a *ser*.

Theorists no doubt object to this, but we must remember it matters little what particular name, nickname, or slang term may remain during the transition period; the essential point is that the *value* of each is known in terms of the metric system. The metric names would follow in due course. Likewise with money; the franc and centime of the Latin Union Countries are both called by ½ doz. distinct names; and it is so, even with our present money, for speaking of a "Crown" or "Dollar" has not prevented it from always being written as 5s. or (1s. 6d. in South Africa, 100 cents in Canada, &c.); one "tanner" as 6d., one "tickey" as 3d. (so-called in South Africa), and "fifteenpence" as 1s. 3d.

In the future, therefore, the old names or nicknames of many of our present denominations can be retained, even if not officially recognised, and the amounts or quantities written in decimal values.

Let us now see then what can be done in the way of adjusting our weights and measures to the Metric weights and measures, and retaining our old names and nicknames.

SUGGESTIONS.

Lineal Measures.

Our yard should be *slightly increased* (10 per cent.) to the length of the meter and called a metric-yard, or meter, according to the fancy of the speaker; and prefixes could be placed in front of the word yard as easily as in front of the word meter. The meter and its multiples and sub-multiples would then also be called *milliyard, centiyard, deciyard, metric-yard,* dekayard, hektoyard, and kiloyard.*

In practice, however, as previously explained, we should seldom require to use so many prefixes, which greatly simplifies matters.

Thus the distance of

Kilo yard	Hekto yards	Deka yards	Metric yards	Deci. yards	Centi. yards
1	4	2	8	5	7

would be briefly expressed either as 1428·57 metric-yards or 1·42857 kiloyards.

We could not to-day convert miles, furlongs, poles, yards, and feet, into yards, and decimal parts of a yard, without a long sum in arithmetic, and longer calculations still would be required to again express these yards in either Nautical measurements or Cape roods, or Chains and Links.

At present we require to divide our inch in several different ways, whereas the millimeter is minute enough to overcome all difficulties. What is the use now of dividing our inch into 128 equal parts when it is easier for machinery to test its accuracy in hundredths and thousandth parts.

In future, yards, feet and inches will give way to metric-yards, deci-yards, and centi-yards. An inch would be defined in the new Act as meaning 25 millimeters or milliyards, 4 inches or one hand as 1 deciyard, a foot as 3 deciyards. A draper's metric-yard would be emphasised in eighths like the present one, and show up one end 1 deciyard and ¼ deciyard (4 in. and 1 in.).

* During the transition period.

We should soon be able to realise the length of the multiples of the metric-yard, if we remembered twenty *were the length of a cricket pitch;* the hektoyard was *the length of a football ground,* and the kiloyard or kilometer about equalled $\frac{5}{8}$ or $\frac{6}{10}$ of a mile, and therefore what we previously called a Five-mile race would in future be called the *Eight kiloyard race.* Also that a mile=about $1\frac{6}{10}$ kiloyards, and 1 kiloyard $=\frac{6}{10}$ mile.

Miles, furlongs, poles and yards are, in long distances, expressed in miles and yards only; these would give way to kiloyards and metric-yards. If Nautical Measures were also changed, knots would be replaced by kiloyards or kilometers (40,000 to the Earth's circumference), a cable's length would be 200 metric-yards instead of 200 present yards, and a fathom 2 metric-yards instead of about 2 present yards (see page 169).

On railways the "Railway Mile" would be 1,500 meters.

Superficial Measures.

Sq. feet and sq. inches would give way to sq. deciyards and centiyards.

The square yard and 10 square Quebec feet would give way to the metric yard or centiar.

Four sq. poles would give way to the sq. dekayard or Ar.

Roods would give way to 1,000 square metric-yards.

The Ploughman's "Acre unit" for heavy lands would become 4,000 sq. metric yards. On light lands the acre would be displaced by the $\frac{1}{2}$ Hektar.

The Scotch acre would give way to the $\frac{1}{2}$ Hektar.

Three arpents, $2\frac{1}{2}$ acres or 1 morgen* in future would equal the sq. hektoyard or Hektar.

Three hundred arpents, 250 acres or 100 morgen, in future would equal 1 sq. kiloyard.

The names of centiar, ar, hektar and square kilometer (or kiloyard) are used in reference to land only, and would soon appeal to us as being figures of which, if square, the sides would respectively be 1, 10, 100, and 1,000 meters or metric-yards.

In Quebec, the French-Canadian would most probably prefer the modern French hektar to three old French square arpents.

* See also the old Irish and Welsh acres and the Indian Bigah.

For South Africa, Mr. D. E. Hutchins, Conservator of Forests, Cape Colony, points out that the hektar would make a good land-unit, being so near the morgen in size, and yet better proportioned to the acre than the present morgen is. Alterations in land measurements would perhaps be as difficult as all the other changes put together. That this suggestion should come from a gentleman so highly interested in land areas is therefore of the highest importance.

Cubic Measures.

Cubic yards, feet and inches, would give way to cu. metric yards and cu. centiyards.

Shipping tons expressed in cubic feet would be replaced by cu. metric yards, a cu. metric yard of fresh water weighing one metric ton (see page 50).

Weights.

Nearly all weights are now reckoned by Britishers in pounds avoir., and its multiples and sub-multiples, without reference to any other unit. We should *slightly increase* (10 per cent.) our present pound, so as to make the new pound equal to the $\frac{1}{2}$ kilogram, and the "bi-pound" or "double-pound" equal to the kilogram.

One ounce* would be defined in the new Act as meaning (after a certain date) 25 or perhaps 30 grams.

$\frac{1}{4}$ lb.	would	be	defined	as	1	hektogram.
$\frac{1}{2}$ lb.	,,	,,	,,	,,	$\frac{1}{4}$	kilogram.
1 lb.	,,	,,	,,	,,	$\frac{1}{2}$	,,
2 lbs.	,,	,,	,,	,,	1	,,
A short cwt., or 100 lbs., and a long cwt., or 112 lbs. †	,,	,,	,,	,,	50	kilogs., or 1 centner.
A short ton, or 2,000 lbs. and a long ton, or 2,240 lbs. †	,,	,,	,,	,,	1	tonne or millier.

* Whether Avoir. or Troy and Apoth. The Avoir. oz. is 28 grams, and the Troy 31 grams.

† Thus the Metric denominations would be compromises between the Imperial or "long" cwt. and ton, and the Colonial or "short" cwt. and ton.

A quantity expressed in tons, cwts., qrs., and lbs., would in future be more simply given in tons and kilogs.

In a compulsory Act, it would most probably be better to allow the Troy ounce used for bullion, &c., to remain untouched until the standard pound sterling were made of the weight of 8 grams exactly (it is now 7·93787 grams, with a remedy between 8·00101 and 7·97509). However, if the Bank of England were to reckon in grams, all bullion dealers would too.

If Jewellers' ancient weights were not allowed to remain in use, the "diamond carat" could be defined as a weight of not less than 200 milligrams, and the "pearl grain" as a weight of not less than 50 milligrams.

For Medicines, Metric denominations have been inserted in the Pharmacopœia since 1898.

Measures of Capacity.

Practically all dry goods are now sold by weight, and liquids are measured by the British almost entirely by the gallon or pint, without reference to any other units. We should *slightly increase* (10 per cent.) our present gallon so as to make it equal to the $\frac{1}{2}$ dekaliter; and the gallon, being larger, could then, instead of being divided into 8 equal parts as at present, be divided into 10 equal parts called metric pints, each equal to $\frac{1}{2}$ liter.

The Gill would be defined in the new Act as meaning (after a certain date) 1 deciliter = $4\frac{1}{2}$ ozs. water instead of 5 ozs.

The Pint	would be defined as	$\frac{1}{2}$ liter	=	$1\frac{1}{10}$ lbs. water instead of $1\frac{1}{4}$ lbs.
„ Quart	„	„	„	1 liter	=	$2\frac{1}{5}$ lbs. water instead of $2\frac{1}{2}$ lbs.
„ Gallon	„	„	„	$\frac{1}{2}$ dekaliter	=	11 lbs. water instead of 10 lbs.
„ Bi-gallon or Peck	„	„	„	1 dekaliter	=	17·6 pints instead of 16 pints.
„ Old Muid (S. Africa)	„	„ revived	„	1 hektoliter	=	$2\frac{3}{4}$ bushels.

"This metric muid will measure $2\frac{3}{4}$ bushels which is perhaps nearer the size of the common muid sack of grain than the 3

bushels it is supposed to contain." (*Mr. D. E. Hutchins*, Cape Colony).

Note Well.

In each case, the suggestion has been to *slightly increase* (by 10 per cent.) our present "primary units"—for the yard, pound, and gallon are the primary units mentioned in sections 10, 13, and 15 of the Weights and Measures Act, 1878, from which the other units are to be derived.

Foreigners, when buying, naturally prefer the 10 per cent. larger metric weights and measures, decimal in progression, to our present corresponding smaller ones, of mixed progression. And wherever, within the Empire, the Metric Weights and Measures are legal, Britishers should remember to order by them, instead of by the usual smaller weights and measures. And the man who sells by the larger weights and measures will secure more custom than he who sells by smaller ones. He will be amply repaid, too, by the saving of time in his calculations. But he would prefer to say, "My pound is heavier than my neighbours," than, "My half-kilogram is heavier than his pound."

"Adjust," not "Bundle Out."

Advocates of the Metric System should remember that all British reforms come by "Evolution," and not by "Revolution." Britishers prefer being led to being driven. Tell them that their cumbrous system will be *adjusted*, and they will listen. But if they are told it will be *bundled out*, and a foreign one take its place, they will turn a deaf ear.

LINEAL MEASURES

(See also page 133.)

Practical equivalents:—

A Yard is 10 per cent. less than a Meter.
A Meter is 10 per cent. more than a Yard.

The Meter may be termed the "Metric Yard."

Yards and Meters, in Tens, Dozens, and Hundreds.

11 yards	=	10 meters.	70 yards	=	64 meters.
12 ,,	=	11 ,,	100 ,,	=	91 ,,
22 ,,	=	20 ,, *	110 ,,	=	100 ,,

Other approximations :—

$\frac{1}{8}$ inch	=	3 millimeters.†	100 feet	=	30 meters.
1 inch	=	$\frac{1}{4}$ decimeter.	1100 yards or $\frac{5}{8}$ mile	=	1 kilometer.
4 inches	=	1 decimeter.			
5 inches	=	$\frac{1}{8}$ meter.	1 mile	=	$1\frac{5}{8}$,,
1 foot	=	3 decimeters.	5 miles	=	8 ,,
1·1 yard	=	1 meter.	$12\frac{1}{2}$ miles	=	20 ,,

Commercial measurements are expressed in meters and centimeters.
Engineering ,, ,, meters and millimeters.
Minute Scientific ,, ,, centimeters and millimeters.

Scientific equivalents ‡ and International symbols :—

The multitude and variation in the figures arise from the fact that Imperial measures proceed in multiples of $5\frac{1}{2}$, 1760 and so on, irregularly, whereas the Metric denominations all move in **Tens.**

For Converting	Into	Multiply by	Converse
Millimeters (*mm.*) §	Inches	·03937	25·400
Centimeters (*cm*)	,,	·3937	2·540
Decimeters (*dm.*)	,,	3·937	·254
METERS (*m.*	,,	39·370113	·0254
	Feet	3·280843	·3048
	YARDS	1·0936143	·914399
	Poles	·1988	5·0292
	Links	4·970974	·201168
	Chains	·0497	20·1168
Dekameters	Non-essential		
Hektometers (*hm.*)	Yards	109·3614	·009144
Kilometers (*km*)	,,	1093·6143	·0009144
	Miles	·62137	1·6093

For Cape, Quebec, and other comparisons, see pages 47 and 48.

* 22 yards = 1 chain. A 20 meter measure has recently been laid down on the stone floor on the west side of Westminster Hall.

† Cutting of screw threads for example.

‡ The fundamental units are carried out to a greater number of decimal points than the other units. The names are often abbreviated ; such as *millim, centim,* &c.

§ A Micron (μ) = 0·001 mm.

The hektometer is probably non-essential also, as we should speak of Meters in hundreds.

SUPERFICIAL MEASURES.

(See also page 134.)

Practical Equivalents :—

A sq. yard is 20 per cent. less than a sq. meter.
A sq. meter is 20 per cent. more than a sq. yard.
1 acre = ·4 Hektar, *i.e.*, the Metric Acre = 4,000 sq. meters.

Scientific Equivalents and International Symbols: —

The multitude and variation in the figures arise from the fact that Imperial measures proceed in multiples of 144, 30¼, 640 and so on, irregularly, whereas these Metric denominations all move in Hundreds.*

For Converting	Into	Multiply by	Converse.
Square Millimeters (*mm.²*)	Square Inches	·00155	645·16
„ Centimeters (*cm.²*)	„ Inches	·15500	6·4516
„ Decimeters (*dm.²*)	„ Inches	15·500	·064516
	„ Feet	·10764	9·2903
„ Meters (*m.²*)	„ Feet	10·7639	·092903
or Centiars (*ca.*)	„ Yards	1·1960	·836126
„ Dekameters	„ Yards	119·60	·008361
or Ars (*a.*)	„ Poles	3·954	·25293
	Roods	·098844	10·117
„ Hektometers	Acres	2·4711	·40458
or Hektars (*ha.*)	Square Miles	·00386	259·00
„ Kilometers (*km.²*)	„ Miles	·386	2·5900

The names of centiar, ar, and hektar are used only in reference to Land. The denominations of deciar and dekar, meaning respectively 1-10th ar and 10 ars, are not in use, for reason given in second footnote on page 120.

The Hektar is the chief unit for land, and the square Kilometer is used for expressing large areas, such as counties, continents and oceans.

For Colonial and other comparisons, see pages 46 to 48.

To reduce kilograms per sq. centimeter to lbs. per sq. in. × 14·2228; converse × ·07031.

* See second footnote page 120.

CUBIC MEASURES OR MEASURES OF VOLUME.*

(See also page 135.)

Practical Equivalents:—

A Cu. Yard is 30 per cent. less than a Cu. Meter.
A Cu. Meter is 30 per cent. more than a Cu. Yard.

Scientific Equivalents and International Symbols:—

The multitude and variation in the figures arise from the fact that Imperial measures proceed in multiples of 1728 and 27, whereas these Metric denominations all move in **Thousands.**

For Converting	Into	Multiply by	Converse.
Cubic Millimeters (*mm.3*)	Cubic Inches	·000061	16387
Cubic Centimeters (*cm.3*)	" "	·0610	16·387
Cubic Decimeters (*dm.3*)	" "	61·024	·016387
Cubic Meters (*m.3*)	" Feet	35·3148	·028317
	" Yards	1·307954	·764553

WEIGHTS.

Basis: The **Kilogram,** being the weight of one Cubic Decimeter of water (see first footnote, page 120, and diagram, page 121).

The multiples of the Quintal and Ton were added to meet the requirements of Commerce.

---

* When the Metric System was first established, the cubic meter was designated a "*Stère,*" and its gradations were in tens instead of in thousands, but this name and these denominations have to a large extent fallen out of use, for three reasons: (1) Because only the lowest submultiple and highest multiple were convenient for use, namely, the millistere (= 1-1000th of a Stere) and the myriastere (= 1000 Stere), the reason for which has already been explained on page 120; (2) Because the millistere (= 61 cubic inches) was not small enough for many requirements and the myriastere (= 13,080 cubic yards) was too large to be often referred to; (3) Because it was simpler to call the cubic measures after the lineal measures, which moreover surmounted all difficulties.

Practical Equivalents:—

A "Bi-pound" is 10 per cent. less than a Kilogram.
A Kilogram is 10 per cent. more than a Bi-pound.

In other words:—

To convert Pounds to Kilogs., deduct 10 per cent. and divide by 2.
" " Kilogs. to Pounds, add 10 per cent. and multiply by 2.

(See also page 135.)

Scientific Equivalents and International Symbols:*—

The multitude and variation in the figures arise from the fact that Imperial weights proceed in multiples of $27\frac{11}{32}$, 16, 112 and so on, irregularly, whereas the Metric denominations all move in **Tens.**

For Converting	Into AVOIR.	Multiply by	Converse.
Milligrams (*mg.*)†	Grains	·015432	64·8
Centigrams (*cg.*)	"	·154	6·48
Decigrams (*dg.*)	"	1·543	·648
Grams (*g.*)	"	15·432	·0648
	Drams	·5644	1·772
	Ounces	·03527	28·350
Dekagrams	Non-essential		
Hektograms (*hg.*)	Ounces	3·527	·2835
KILOGRAMS (*kilogs. or kg.*)	Grains	15432·3564	·0000648
	Ounces	35·27	·02835
	POUNDS	2·2046223	·45359243
	Cwts.	·01968	50·80
	Tons	·00984	1016.
Myriagrams	Non-essential		
	Pounds	220·46	·0045
Quintals (*q.*)	Cwts. (short)	1·814	·5511
	" (long)	1·968	·5080
Tonnes (*t.*)	Tons (short)	·9072	1·1023
	Tons (long)	·9842	1·0160

* The fundamental units are carried out to a greater number of decimal points than the other units.
† A Microgram (*y*) = 0·001 *mg.*

For certain trade purposes the French also adopt :—

The half-kilo, or Metric Pound,	1·1 lb. avoir.
The stone of 6 kilograms,	13¼ " "
The Centner, metric hundredweight, or half-quintal of 50 kilos.	110¼ " "

(The latter is a compromise between the Imperial or "long" cwt. and Canadian and South African or "short" cwt.)

For Converting	Into TROY and Gem Dealers' ancient weights	Multiply by	Converse.
Milligrams, Centigrams, Decigrams, Grams	Grains	*as*	*above*
Milligrams	Pearl Grains	·01929	51·84
"	Diamond Carats	·00487	205·23
GRAMS	Old Pennyweights	·643	1·5552
	Ounces Troy	·03215	31·1035

For Converting	Into "Old" APOTH.	Multiply by	Converse.
Milligrams, Centigrams, Decigrams, Grams	Grains	*as*	*above*
GRAMS	Scruples	·7716	1·296
	Drams	·2572	3·888
	Ounces	·03215	31·1035

MEASURES OF CAPACITY.

(Liquid and Dry.)

Basis : the Liter, being one cubic decimeter of water, weighing one kilogram (*see* first two footnotes, p. 120, and diagram, p. 121).

Practical Equivalents :—

A "Bi-gallon" is 10 per cent. less than a Dekaliter.
A Dekaliter is 10 per cent more than a "Bi-gallon."

In other words :—

To convert Gallons to Dekals, deduct 10 per cent. and divide by 2.
„ Dekals to Gallons, add 10 per cent. and multiply by 2.

(See also page 136.)

Scientific Equivalents * and International Symbols :—

The multitude and variation in the figures arise from the fact that Imperial measures of capacity proceed in multiples of 2's, 4's, and 8's, irregularly, whereas the Metric denominations all move in Tens.

For Converting	Into	Multiply by	Converse.
Milliliters (*ml.*) Centiliters (*cl.*)	There are no British denominations so delicate as these.		
Deciliters (*dl.*)	Gills	·70	1·42
	Pints	·176	5·682
LITERS (*l.*)	„	1·75980	·5682
	Quarts	·880	1·136
	GALLONS	·219975	4·5459631
Dekaliters (*dal.*)	„	2·19975	·4546
	Bushels	·275	3·637
Hektoliters (*hl.*)	„	2·75	·3637
	Quarters	·34381	2·909
Kiloliters (*kl.*)	Gallons	219·975	·004546
	Bushels	27·5	·03637
	Quarters	3·4381	·2909

* The fundamental units are carried out to a greater number of decimal points than the other units. The names are often abbreviated, such as *dekals, kilos*, &c.

For converting	Into APOTH'S. Fluid Measure.	Multiply by	Converse.
Milliliters	Minims	16·9	·059
	Drams	·2816	3·552
Centiliters	"	2·8157	·3552
	Ounces	·3519	2·84123
	Pints	·0176	56·82
Deciliters	Ounces	3·5196	·284
	Pints	·1759	5·68
LITERS	"	1·7598	·568
	Gallons	·2199	4·5459631

For Cask and other comparisons, see pages 65 to 67.

ORDNANCE SURVEY MAPS (British Isles) and the METRIC SYSTEM.

The Ordnance Survey Department (headquarters, Southampton) is a permanent military and civilian establishment, now under the control of the Board of Agriculture and Fisheries, but a separate vote (£208,000) is annually made for the Department.

Maps are published of every portion of the United Kingdom in several scales. Those employed for the "Old Town Maps," were in whole feet to the mile, namely 10 feet or 5 feet, being respectively $\frac{1}{528}$ and $\frac{1}{1056}$ of the actual length on the ground.

But when a few towns had been mapped in these scales, the Director-General of the Ordnance Surveys, foreseeing that a system of land measurements must inevitably be introduced which was decimal *throughout*, even if it were not the Metric system, abandoned the original scales for **Decimal Scales.** The "New Town Maps" as they are styled, were therefore made to the scale, commonly known as the $\frac{1}{500}$, which has the advantage of being expressible in any denomination required; thus 2 feet to 1000 feet, 2 yards to 1000 yards, 2 meters to 1000 meters or kilometers, 2 mm. per meter, and so on. Most towns in the United Kingdom are mapped to this decimal scale.

The "Parish Maps" which are already complete for the whole of the cultivated districts of Great Britain, and Ireland nearly, are to the scale of $\frac{1}{5}$ of the New Town Map, that is to say $\frac{1}{2500}$, or 4 yards per 1000 yards, or 4 decimeters per kilometer. For Towns, they were obtained by revising the Town Maps, which were then reduced by photography (before the lettering was filled in), but no revised Town Maps are now prepared except at the expense of the Towns themselves.

The "County Maps" were plotted on the old system of 6 inches to the mile ($\frac{1}{10560}$); similarly the "Road Maps" are one inch to the mile ($\frac{1}{63360}$), and the "Index Maps" $\frac{1}{2}$ inch or $\frac{1}{3}$ inch to the mile. These maps have for some time been complete for the whole of the United Kingdom; their revision is also finished. But revision is no longer made by plotting to these scales, but through revising the larger maps and reducing by photography.

Taking the length of any of the maps from north to south as one, the breadth from east to west is $1\frac{1}{2}$.

The sheet-lines or edges of the map can be made to enclose any areas, but the system adopted is so that twenty-five Town Maps on the lineal scale of $\frac{1}{500}$ fit into one Parish Map, on the scale of $\frac{1}{2500}$; also that sixteen of these Parish Maps, in their turn, fit into one County Map, on the scale of $\frac{1}{10560}$. And so on, until eventually the scales are small enough for the whole of England and Wales, for example, to be on one sheet.

It is evident that with a system of irregular multiples in our measures of length, instead of a decimal or other regular system throughout, that if the scale to the mile and the sheet-lines of one scale of maps are to be in a whole number of inches, then the scale to the mile and the sheet-lines of another set of maps must be a broken number of inches.

Thus the scale of the County Map is six inches to the mile and of the Parish Maps 25·344 inches, and the former maps are 36 inches × 24 inches and the latter 38·016 inches × 25·344 inches.

It requires no further explanation to show that such a system of measures necessitates intricate calculations before sixteen of the Parish Maps can be photographed down to one County Map smaller each way by inches and fractions. To avoid this, the County Maps will undoubtedly one day be photographed from the scale of $\frac{1}{2500}$ to the scale of $\frac{1}{10000}$ or $6\frac{1}{3}$ miles to the inch, instead of $\frac{1}{10560}$ or 6 miles to the inch.

At the same time the length of the sheet-lines could be altered, without affecting either the survey or the scale, to 39·37 inches by 23·64 inches, *i.e.*, 1 meter by 6 decimeters. Then the actual ground lengths and areas represented on each sheet would be :—

	Meters.	Areas in Hektars.	Areas in Sq. Kilometers.*
Town Maps	500 × 300	... 15	... ·15
Parish Maps	2,500 × 1,500	... 375	... 3·75
County Maps	10,000 × 6,000	... 6,000	... 60

We have seen that the Parish Maps are on a scale of four decimeters to the kilometer, and the Town Maps of two meters to the kilometer. It is astonishing that no metric scale is marked on them and that the areas are shown in acres and decimal parts only (rules being given for conversion to roods and poles) when it is easier to calculate areas on a decimally scaled map † in metric lineal and superficial measures.

The spot-levels are also shown in feet and decimal parts of a foot only.

If the Metric System is to be given a fair chance, metric measurements and areas, should be shown on the maps which are published not merely as geographical pictures, but for use by engineers and others for a great variety of purposes. The purchasers of the sheets are all consequently hindered from using the Metric System in their other work, instead of encouraged in same.

From an educational point of view, too, the showing of metric denominations would be an immense advantage to the country in general and school children in particular. For it may not be generally known that under the New Education Code a child's introduction to maps and geography is sometimes through the Ordnance Maps of the district in which he lives.

A child is therefore instructed in arithmetic in the Metric System and sometimes, within a few minutes, is during the geography class shown a map, in reality drawn to the scale of 4 decimeters to the kilometer, but upon which the following scales are shown :—

* Note the ease with which the areas are calculated and converted from hektars to square kilometers ; incomparably quicker than converting acres to square miles

† Areas are not shown on the non-decimal $\frac{1}{10,560}$ scale Maps.

(*a*) 1 inch to 3·156 chains.
(*b*) 1 inch to 208·3 feet.
(*c*) 1 inch to ·0395 mile.
or (*d*) 25·344 inches to the mile.

Or if the Map is a Town Map, in reality drawn to 2 meters to the kilometer (which is the same as 2 mm. to the meter), the scales are marked on as :—

(*a*) 1 inch to 41·66 feet.
(*b*) 126·72 inches to the mile.
or (*c*) 10·56 feet to the mile.

Poor child ! !

Surely an extra Government grant could be made if needs be, to have the metric scales and areas marked on the maps.

THE COMBINED EFFECT OF DECIMALISING WEIGHTS, MEASURES, AND COINAGE.

The purpose of the following paragraphs is not to discuss the saving of labour which the suggested reforms would occasion when carried out, but to remove the prejudice existing in some minds against them, more especially regarding the proposed reduction of the exchange value of the copper coinage by 4 per cent.

As already pointed out, the decimal coinage suggested affects Small Transactions in which copper coins must be used, and Large Undertakings the revenues of which are fixed by law or peculiar circumstances on the basis of the Penny.

The first division presents no difficult problems, as the metric quantity and price of commodities would be regulated between Retailer and Consumer by adding a similar percentage to the wholesale cost as the present profits require. It is impossible for any single person to deal with the technicalities in every Trade ; each has its Association and Journal to work out its own salvation, and these would elucidate any minor difficulties which may present

themselves. The object of all should be to remove and not to raise obstacles. Each trade and profession with the advice and consent of the Board of Trade* could choose its own day for transferring from one system to another. Thus Goldsmiths and Jewellers could all change with the Bank of England independently of any other non-allied business.

The notable examples in the second division are Railway, Dock, and similar Companies, the revenues of which are now fixed on the Penny by Statute, the General Post Office and Newspapers the receipts of which, other than charges for advertisements, are similarly based.

Our comments on the Railway Undertakings will not apply to so great an extent to Government-owned Railways (as in the Colonies) where the profits accrue to the State.

RAILWAY COMPANIES.

The usual argument and its rebuttal :—

The objection generally raised is that reducing the value of the penny 4 per cent. (an almost inappreciable reduction in other instances) would render all our Railway Companies non-payable. This statement might be true if the coinage was altered without changing the Weights and Measures. But in the case of Railways the change to metric measures and decimal coinage must be simultaneous.

The combined effect of a meterage charge by decimal coinage and metric freightage has an entirely opposite tendency to that held by pessimists and supported by those of a *laissez faire* temperament.

The facts :—

For 100 pence one can now travel 100 miles = 160·93 kilometers. The proposal is to reduce the exchange value of the penny 4 per cent. Therefore the number of kilometers must be reduced by 4 per cent. or 6·43 kilometers, = 154·5 kilometers.

If the ratio could be preserved exactly, therefore, for 100 new pennies, we should travel 154·5 kilometers, or for 1 new penny a distance of 1,545 meters.

* That is to say if the new weights and measures are to be supplied by the Government.

For the rate to be a convenient one, however, dues now 1d. per mile would require altering to one new penny for a "RAILWAY MILE" of 1,500 meters or 1½ kilometers. This would operate in favour of the Railway Companies to the extent of 3 per cent.*

The same percentage would apply to freights of goods, excepting that the Metric ton (2,204½ lbs.) is 1½ per cent. lighter than the ton of 2,240 lbs.†

The increased profits, however, would not, even in the ordinary course of things, all go to the shareholders, for Railway Companies contribute to the Local Taxation or Rates a considerable percentage of their net mileage earnings. A reduction in the Local Taxation, therefore, would be one of the first benefits accruing to the public.

The balance of the increased earnings could either be applied by a special Rating Bill, to a further reduction of the Local Taxation, or, by a special Tax on Railways, go into the Exchequer.

This new Tax would wipe out the comparatively small Imperial Expenditure incurred in supplying new weights and measures to every individual and local authority now using same, and models in the schools, after which it could be applied to any other source (widening roads &c.)

The expense to the Railway Companies of marking out their railroads with pegs, in kilometers or Railway Miles instead of in Imperial Miles, could similarly be borne by the nation, or the Companies allowed to raise a small further capital, so as not to interfere with any dividend for any half-year.

At the same time the Government could bargain with the Companies for the free conveyance of Mails or Volunteers. The system of reckoning distances "as the crow flies" (the zone or radius system) might also be introduced, and books of tickets issued for, say, 1,000 Railway Miles, to be taken out as desired. But the details of the *quid pro quo* to be obtained by the nation from the Railway Companies need not be discussed here.

Note.—It was the advent of Railways that made the measures of capacity all but obsolete for Dry Goods, becauses the charges are by weight. It will be seen, therefore, that unless Railway Companies are authorised to adopt the entire Metric System (and consequently Decimal Coinage), a Reforming Act will be almost a dead letter.

* 45 in 1,545 or 4·5 in 154·5, or a trifle under 3 per cent.

† In several Colonies the present ton is 2,000 lbs., which counteracts the 3 per cent. for goods and passenger traffic in favour of the State Railways.

DOCK DUES, &c.

Presuming a Register Ton of shipping continued to be 2·83 cu. meters (see page 53), the reduction in the value of the penny would be practically counteracted by adding 4 per cent. to the total sum due from any ship.

Suppose for example, a ship of 1,500 tons net Register now pays dues at 1d. per ton, it pays altogether 1,500 present pence = 125 shillings = £6 5s., or £6·250. The rate of 1d. would become 1 new penny or 4 mils. + 4 per cent. = 6,000 mils. + 240 mils. Total £6·240. And so on for multiples of the penny.

Anything gained or lost on Tonnage Dues can be counteracted in the wharfage charges.

THE POST OFFICE.

The cost of postage on most letters would be reduced 4 per cent., but the maximum of 4 ounces (113½ grams) being altered to 100 grams, would cause the heavier letters to pay a higher charge (a more equitable distribution). The Post Office is not like a Private Undertaking, and a trifling loss or profit would adjust itself.

International postal arrangements would be greatly simplified.

TITHES.

The Present System.

By the Tithe Act of 1836 all Tithes formerly paid in kind were made payable in money. For this purpose, the average value of the Tithes received by an Impropriator or Rector during the seven preceding years was deemed to have been equally contributed, as regards *value*, by the three cereals—wheat, barley, and oats.

Thus, if the average value of a Tithe for the seven years ending 1835 was £100, this sum was said to have been theoretically made up as follows :—

94·96	Imperial bushels of	Wheat at 7s. 0¼d.	=	£33·3
168·42	„ „	Barley at 3s. 11¼d.	=	£33·3
242·42	„ „	Oats at 2s. 9d.	=	£33·3
				£100

By 1882 the custom of selling cereals by weight had largely increased, owing to the introduction of railways which charge by weight, and the Corn Returns Act of that year enacted that an Inspector should convert into Imperial bushels all returns made to him in weight, or weighed measure, at the rate per bushel of 60 lbs. for wheat, 50 lbs. for barley, and 39 lbs. for oats (see page 24).

How It Works.

The evidence given before the Select Committee on Corn Sales (Parliamentary Paper 279, 1892) clearly showed that the present system of fixing the average price of corn was by no means reliable. In fact, the "legal price" might mean anything but the "actual" price.

Mr. H. Williams, who was selected to attend as a witness by the Associated Chambers of Agriculture, demonstrated that a barley lighter than 50 lbs. to the bushel could be sold by measure and thus make less price than if sold at per bushel of 50 lbs. On the other hand, a barley weighing, say, 54 lbs. per bushel, sold by measure increased the price per bushel, and hence the value of Tithe.

Major Craigie pointed out that a person can buy a parcel of oats by the weighed bushel of, say, 42 lbs., and sell the same parcel by the measured bushel of probably about 37 lbs.

The same parcel of oats could therefore be either returned twice over, or at whichever price the dealer chose. The Inspector could seldom adjust such matters, as he was generally only informed of the number of bushels sold.

Further evidence showed, too, that under such circumstances the price might, or might not, contain the repayment of carriage.

The Chairman pointed out that throughout one day no Inspector was present at Wolverhampton Market, and that from the majority of market towns no return whatever was made during the whole of the year.

Mr. Sapwell stated that he never knew of a case in which a farmer made a return unless he was a dealer also, whilst another witness admitted that even the Statistical Department of the Board of Agriculture had some uncertainty as to the meaning of the word bushel, owing to the various local customs.

The Inspector of Corn Returns at Mark Lane said that the weight per bushel or quarter of the corn sold by sample was shown in the

returns made to him. He had a series of tables worked out in various weights for conversion into the "statutory bushel." Taking an easy example in which all adjustments were at 5 per cent., he said, "I get a return of, say, 100 quarters of 63 lbs. at 40s.; that means 105 quarters of 60 lbs. at 38s." He would only be in favour of a uniform weight of 100 lbs. if we had decimal coinage also.

The Metric System and Decimal Coinage.

A person would have to be very biassed against a change to the Metric System before he could say that compulsory sale of corn "at per 100 Metric pounds" would seriously affect the value of Tithe ascertained under the rule-of-thumb systems above exposed.

The exact equivalents of the number of bushels and the price fixed in 1835, is as follows:—

34·351	hektoliters of	Wheat at	£0·96525	.. ..	= £33·3
61·244	„	„ Barley at	£0·5445	.. ..	= £33·3
88·154	„	„ Oats at	£0.378125	.. ..	= £33·3
				Total	£100

But for the purpose of obtaining simple figures, an Act could be passed so that we assumed the statutory bushel of oats to be 40 lbs., and that in 1835 the average prices of the three cereals were as follows:—

Wheat, 6s. 11d.; Barley, 4s. 0½d.; Oats, 2s. 8¼d.

The par value of Tithe would then be Metrically made up in Decimal parts of the sovereign as follows:—

35	hektoliters of	Wheat (at 150 Metric pounds)		at £0·9524	= £33·3334
60	„	„ Barley (at 125	„ „)	at £0·5555	= £33·3333
90	„	„ Oats (at 100	„ „)	at £0·370	= £33·3333
				Total	£100

NOTE.

These figures, by themselves, would increase the average value of Tithe for the years 1835 to 1903, as given in Willich's Tithe Commutation Tables, *a very small fraction indeed* (upon which Rates would be paid as usual). But the effect of selling Norfolk malting barley by weight instead of by measure (see Parliamentary Paper, above referred to) would neutralise that difference.

THE PRESS.

With newspapers, the loss of 4 per cent.* in the value of the Penny could not be met by supplying a smaller amount of information.

But as 25 pennies would equal 1 florin instead of 24, the sales of newspapers would undoubtedly be largely increased, and what at first sight appears a further loss could be turned to a profit, as presently shown.

The papers are supplied the Trade upon varying terms, such as 13 for 9d., or so many for 1s. A portion of the adjustment would, therefore, be made here (for the ¼ florin and ½ florin would not alter in value), and the number of papers supplied newsvendors for a certain price would most probably be simplified. Thus 13 for 9d. would equal 13 for 37½ new farthings, which if altered to 10 for 29 new farthings (¼ florin and 1 new penny) would be very slightly in favour of the newspaper Proprietor. Thirteen for 9d. allows the vendor 30 per cent., 10 for 30 new farthings only 25 per cent., but on a larger turnover. And so on.

The rate paid for articles written at per line would most probably not be altered, but newspaper postage would be reduced 4 per cent.

Advertisements, never costing less than 6d. now, are not *actually* on a penny basis, although *nominally* they may be. **The Papers, from the increased sale, would be worth more as advertising mediums,** and Advertisers, being usually keen men, would not fail to appreciate the fact, if the combined Press slightly adjusted their Tariffs.

The author has no hesitation, therefore, in including the decimal coinage proposal as a corollary to the general introduction of the

* It would be barely 4 per cent. if the weight of the sovereign was defined as 8 grams (page 93).

Metric System, but relies in a matter of such national and international importance upon a Patriotic and Up-to-date Press, prepared, as hitherto, to discuss a subject from the point of view of the Empire's welfare, and without studying its own temporary inconvenience.

OTHER INTERESTS.

Should any isolated instances arise of a peculiar trade being injured (which hardly seems possible), the Government would have funds in hand from the Railway Companies (Decimal System) Tax to meet any warrantable claim.

SUMMARY OF PROPOSED REFORMS.

(Several often taking place concurrently.)

1. Issue of Models or Facsimiles of Metric denominations to all Public Schools, and Private Schools under certain circumstances (page 129).

2. Issue of Metric Standards to all local authorities; to be on Exhibition for, say, 1 month (page 131).

3. Placing by Government of mural tablets of the meter on the principal Public building in each Town (page 129).

4. Distribution of meter measures by Inland Revenue Authorities, 1 or more for every inhabited house (page 129).

5. The standard sovereign increased in weight to 8 grams; in value, less than 8d.* (page 93).
Passing of a Light Coinage Act.

6. Abolition of Troy Weight, and issue to Bankers, Goldsmiths, &c., of Metric and Coin Weights (page 83).

7. Substitution of the Milligram, &c., to replace the Avoir., Grain, Diamond Carat, and Pearl Grain by Jewellers and issue of Metric Weights (page 87).

* Declarations in Pounds Sterling of value of gold won from Mines rendered easy (page 90).

8. Abolition of the Old Apothecaries' Weight, and after 2 years the discontinuance of Avoir. denominations in the Pharmacopœia. Issue of Metric Weights and Measures, to Doctors, Chemists, &c. (page 77).

9. Metric scales to be shown on the decimally plotted Ordnance Maps, in lieu of scales in ordinary Imperial denominations (page 144).

10. Issue of new measuring chains, &c., to all Surveyors, Engineers, &c. (page 129).

11. Marking out of Railroads in Kilometers or Railway Miles (preparatory) (page 148).

12. Marking out of County-roads in Kilometers by County Councils (page 130); the Military perhaps helping.

13. Issue by Post Office of 25 penny stamps for 1 Florin, and introduction of Grams instead of Ounces (page 150).

14. Calling in of three-penny pieces * (page 107).

15. Alteration in design of one side of the Silver Coins (page 106).

16. (*a*) Declaration of Decimal Coinage and issue of cards of equivalents (page 110).

(*b*) Adoption of Metric distances, &c., by Railway Companies (page 148).

(*c*) Adoption of Metric denominations only, at Customs' Houses, &c. (page 129).

17. Issue by the Mint of 25 new pennies for every 24 old ones handed in (page 108).

18. Adoption of the International Metric System by all Trades which had not already done so, taking one or more Trades at a time (page 130).

19. Counterpoise weights to be of some standard weight (page 71).

20. Government compensation to all local authorities and individuals who had purchased metric weights, &c., privately, upon production of Voucher and handing in of old denominations. To be carried out through the Inspectors of Weights and Measures, or the Police.

21. Abolition of Apothecaries' Fluid Measures (page 79).

22. Present ordinary denominations made illegal for all purposes, and issue of Metric weights, &c., at Government expense, in lieu of old ones, stopped after a certain date.

* And issue of a Nickel coin (?) (page 108).

23. Penalty withdrawn for not exposing Tables of equivalents of Metric denominations supplied places of business by the Government.

NOTE.—The Government expenses in connection with the above to be paid out of the new Railway Tax on enhanced profits. After which the Tax to be devoted to other public purposes (page 149).

DISPUTE AS TO DECIMAL COINAGE.

Opinion has hitherto been divided among advocates of Decimal Coinage, as to whether the Sovereign should retain its present value, or be decreased in value to the level of the 25 francs of the Latin Union, or increased so as to correspond with the half-eagle of America.

Let us first consider the effect of reducing its value. It has already been shown that to decimalise the present Sovereign means decreasing the value of the penny 4 per cent., and, therefore, a diminution of the Sovereign by 2d. would mean a further decrease in the value of the penny, and the difference already existing between the British Sovereign and the half-eagle would be further increased. It would also mean an unjust reduction in the exchange value of the whole of the Silver Coinage of India. Moreover, there is not so great an object in having our "gold" monetary unit equal to 25 of the "silver" monetary units of the Latin Union, for at present only one or two Countries belonging to the Union have a 25-franc piece.

Then as to increasing the value of the Sovereign by 6d. or 6¼d. Apart from being inconvenient to Great Britain, Australasia, the Anglo-African Empire, &c., it would unduly raise the value of the whole of the Silver Coinage in India, which is legal tender to any amount, and used for the redemption of Paper Currency. The effect, too, in Great Britain would be to increase still further the extra profits of the Railway Companies, which would be brought about by the combined effect of adopting a Metric Railway Mile with the present Sovereign decimalised. Whereas if Canada, Newfoundland, &c., reduced the value of their gold coins, to con-

form with sterling value, and adopted the proposed Railway Mile, it would counteract the extra profits of the Railway Companies, which other parts of the Empire would tax away (see page 148).

The Sovereign not being decreased to Latin Union equivalent, there can be no harm, as far as that monetary alliance is concerned, in increasing its value about $\frac{3}{4}$d. as advocated on page 93, so as to make it of Metric Weight.* On the other hand the small increase helps to diminish the fall in the value of the penny, and brings the Sovereign a trifle nearer to the gold coins of North America.

It would appear, therefore, that the World's prototype gold coin will be a British Sovereign of present alloy, but weighing, when standard, exactly 8 grams (and there are probably many in circulation to-day of that weight).

That is to say, that eventually the 11 countries of the Latin Union, and the whole of South America, except Brazil, will probably adopt gold 25-franc pieces (or whatever other name they may be called) increased 2$\frac{1}{2}$d. in value, and the German 20-mark piece will be increased 7$\frac{1}{2}$d. in value.

On the other hand, that the United States, Canada, Newfoundland, British Honduras, Japan, Hong Kong, Labuan, and the Straits Settlements will decrease by about 6d., the value of their gold half-eagle pieces (or whatever other name they may be called), and that Mexico will reduce its 5-peso piece about 2d. in value, and Egypt reduce its Pound about 3d.†

Feeling, therefore, that the retention of the Sovereign at approximately its present value is better for Great Britain, better for the Empire as a whole, and for the World at large, the Author trusts that all advocates of Imperial Decimal Coinage will not delay threshing out their differences of opinion, and consider the matter, not merely from a Coinage point of view, but also the effect on India, Railway Companies, &c., adopting Metric Mileage, and so on. It should also be borne in mind that certain Anglo-Asiatic coinage is about to be changed.

* And hence abolish Troy weight, and render easy the declaration of Gold Outputs in Sovereigns.

† It may be noted that the Sovereign is also the approximate mean between gold coins of Scandinavia, Russia, Portugal, and Brazil, worth on an average about 22s., and gold coins in the Ottoman Empire worth about 18s.

WEIGHTS, MEASURES, MONEY, AND TIME IN BRITISH INDIA.*

(*For Notes on the Indian Acts, see page* 35.)

It has already been pointed out, in the Introduction, under the heading of Indian Acts of Parliament, and elsewhere, that the Imperial Parliament is really responsible for the mass of antiquated systems of weights and measures existing to-day in India. For although the names are often alike, yet, from a variety of circumstances, discrepancies have crept in until the weights and measures differ in every Province and State, and in some instances in nearly every village.

The ordinary weight of the people is called a ser or seer, and the usual higher denomination a maund. A seller in the Bazaar will often have varying seer weights, the bargaining in such cases being by weight instead of by price. In many Bazaars there are also buyers' and sellers' weights, as in China.

No harm can be done by repeating that the reason for Imperial responsibility is because, up to the present, it has been considered inadvisable to "gazette" the 1871 Act of India, unifying the Weights and Measures of Capacity on the Metric plan—one which is particularly adaptable to India because of the present interrelation between its weights, measures, and coinage—until the system is about to be sanctioned as the only legal one in England.

If Famines are to be combated, it is particularly necessary that the Trade Relations between the different Presidencies, Provinces, and Districts should be facilitated by a uniform code of weights and measures.

But, apart from famines, the waste of time caused through the prevailing chaos is almost incredible. Take the example given by Mr. A. E. Potter, M.A., Inspector of Schools in Burma, of one article, salt. If it is sent from a Metric-using country, it must first be converted from Metric to Imperial tons on importation ; duty is then paid on it at per maund, and it is sold at per viss, one viss being practically 1½ kilograms. Is this part of our civilising influence ?

* British India, strictly speaking, does not include the Feudatory States. In French and Portuguese India the Metric System is authorised.

But an unofficial unifying process is being carried out by the Railway Companies, as was pointed out by General Richard Strackey, F.R.S., in his evidence before the Committee of the House of Commons in 1895. Not only have the Companies recognised only certain standards of weights, but the Railways are practically all meter gauge, and therefore form an indestructible meter standard spread all over India.

A Practical Solution.

The author estimates the cost of supplying all the people and British Merchants in this vast Empire with new weights and new measures at wholesale price at under 4 millions of pounds (6 crores of rupees). What a chance for Maharajahs and millionaires ! ! But should the Government assist these, or do the work itself, leaving them to help if they wished ?

STATUTORY LINEAL MEASURES.

The "Metric Yard" not having been adopted in England, an Act was passed in 1889 * declaring the only measures of length legally recognised to be :—

		1	Imperial	inch.
12	Imperial inches =	1	„	foot.
3	„ feet =	1	„	yard.†

But the Metric system of count has recently (1902) *been sanctioned for woollen and silken yarns* (*see page* 36 *and page* 71).

NATIVE LINEAL MEASURES.

The cubit or forearm was the Oriental basis or unit for measures of length (see "Old Lineal Measures" in England, page 43). The denominations therefore have varying values in different parts of

* Act 2, of India, 1889 (Measures of Length); the Act does not apparently refer to Square Measures, such as for cloth, land, &c. It has been extended to Burma (see page 37).

† The Imperial Yard is frequently called a "Guz."

India according to the stature of the natives, but either the Metric or the Imperial yard may be taken as an average of the Guz or Guj. In between the Guz and the Coss or Kos there are, generally, no denominations.

The Coss varies considerably, and appears to refer more to the distance a person can walk in a given time than to a measure of length. Thus, towards the Hills, we find it is only about 2,000 guz or yards, or a little more than a mile. In the Great Plains it varies from about 2 miles to 2½ miles, and the most usually accepted distance it implies may be taken as about from 4,000 yards (2¼ miles) to 4,000 meters (= 4 kilometers or 2½ miles).

Bengal (Basis, the Guz).

	1 job or jow	say ½ inch or	6 millimeters.
3 jobs	= 1 ungli or ungulee	„ ¾ „	2 centimeters.
3 ungli	= 1 girah	„ 2½ „	6 „
8 girahs	= 1 hath or cubit	„ 18 „	½ meter.
2 haths	= 1 guz	„ 1 yard or	1 meter.

In some districts—

4 ungli	= 1 moot	say 3 inches or	8 centimeters.
6 moots	= 1 hath	„ 18 „	½ meter.

Madras.

	1 span	say 8 inches or	2 decimeters.
2½ spans	= 1 cubit, hath or moolum	„ 18 to 19½ inches or	½ meter.

Bombay (Basis, the Guz).

	1 tasu,	say 1⅛ inch or	3 centimeters
16 tasu	= 1 hath or cubit,	„ 18 to 19 inches or	½ meter.
24 tasu or 1½ hath	= 1 guz,	„ 29 inches or	¾ meter.

Burma.

	1 thit	say	$\frac{2}{3}$ inch or 2 centimeters.
8 thit	= 1 taim or maik	„	$5\frac{1}{2}$ „ 14 „
4 taim	= 1 toung or saading	„	22 „ 56 „
7 toung	= 1 tha or ta	„	13 feet or 4 meters.
20 thas	= 1 okethapak	„	86 yards or 78 meters.
$12\frac{1}{2}$ okethapaks	= 1 tain or taing	„	1,070 yards or 1 kilometer.
4 tain	= 1 dain	„	$2\frac{1}{2}$ miles or 4 kilometers.

In some districts, the pulgat is equal to an inch or 25 millimeters, and 4 toung = 1 lan or $2\frac{1}{4}$ meters.

LAND, SUPERFICIAL OR SQUARE MEASURES.

The *Biga* or *Beegah*, the principal land unit, varies in almost every village, and consequently its proportionate parts vary too. The following Tables (in fact, all the Indian tables) can therefore be only a guide.

Bengal (Basis, the Biga).

	1 chittack	say	5	sq. yards	or	4	sq. meters.
16 chittacks	= 1 cottah	„	80	„	„	67	„
20 cottahs	= 1 biga	„	1,600	„	„	1,340	„
	$3\frac{1}{30}$ bigas	„	1 acre				
	$7\frac{1}{2}$ bigas					= 1 hektar.	

Madras (Basis, the Kani).

	1 kol	say	24	sq. feet	or	$2\frac{1}{4}$	sq. meters.
24 kols	= 1 guli	„	576	„	„	$53\frac{1}{2}$	„
100 guli	= 1 kani	„	$1\frac{1}{3}$	acres	or	5,350	„
	2 kanis	slightly exceed				1 hektar.	

Bombay (Basis, the Biga).

	1 kati	say	10	sq. yards	or	$8\frac{1}{3}$	sq. meters.
20 kati	= 1 pund or pand	„	200	„	„	166	„
20 pund	= 1 biga	„	4,000	„	„	3,333	„
	3 bigas					= 1 hektar.	

North-west Provinces (Bases, the Guz and Biga).

	1 guz	say	·85 sq. yards	or	·7 meter.
9 guz	= 1 baus	„	$7\frac{1}{2}$ „	„	$6\frac{1}{4}$ „
400 baus	= 1 biga	„	3,025 „ or ·625 acre	„	$\frac{1}{4}$ hektar.
	4 bigas				= 1 hektar.

Assam (Basis, the Loocer).

Say	$1\frac{1}{10}$ *sq. meter*	= 1 loocer.
20	loocers	= 1 cottah.
5	cottahs	= 1 hillisah.
20	„	= 1 poorah.

The Assam cottah and poorah are about one-third the area of the Bengal cottah and biga.

United Provinces of Agra and Oudh.

		1 us – wansee.
20 us – wansees	=	1 sus – wansee.
20 sus – wansees	=	1 kuch – wansee.
20 kuch – wansees	=	1 bis – wansee.
20 bis – wansees	=	1 biswa
20 biswas	=	1 beegah

WEIGHTS.

The Metric system of count has recently (1902) been sanctioned or woollen and silken yarns (see pages 36 and 71).

British India.

Basis: The **Ser**, which weighs practically 1 **Kilogram**, and was so defined in the ungazetted 1871 Act.

Small Weights.

1 dhan or grain	say	$\frac{15}{32}$ grains	or	30	milligrams.
4 dhans = 1 ruttee	„	$1\frac{7}{8}$ „	„	120	„
8 ruttees = 1 masha	„	15 „	„	972	„
12 mashas = 1 tola (or weight of 1 rupee)	„	180 „ / $\frac{3}{8}$ Troy oz. / $\frac{1}{40}$ Av. lb.	„	$11\frac{1}{2}$	grams.
5 tolas = 1 chittack or chuttack	„	900 grains / $1\frac{7}{8}$ Troy oz. / $2\frac{3}{35}$ Av. oz.	„	58	„

Large Weights

16 chittacks = 1 ser or seer say 30 Troy oz. / $2\frac{2}{35}$ Av. lbs. or ·933 kilogram.

40 sers = 1 maund or mun „ $82\frac{2}{7}$ Av. lbs. or $37\frac{1}{3}$ kilograms = $\frac{3}{4}$ metric centner.

In some districts the denominations are differently divided: 3 mashas = 1 sicki or sicca; 15 mashas = 1 kancha; 4 chittacks = 1 powah; 5 sers = 1 pusseree.

Avoir. lbs. ×		$\frac{35}{72}$ or ·486	= seers.
Seers	× $2\frac{2}{35}$ or $\frac{72}{35}$	or 2·057	= Avoir. lbs.
Cwts.	× $1\frac{13}{36}$ „	$\frac{49}{36}$ „ 1·36	= maunds.
Maunds	× $\frac{80}{49}$ „	·735	= cwts.

27 Maunds are a trifle more than 1 Metric Ton.
„ „ „ less than 1 Imperial Ton.

The weights above given are Bazaar Weight. To convert Bazaar into Factory Weight add $\frac{1}{10}$, or 10 per cent. That is to say, Bazaar Weight is $1\frac{1}{10}$ times Factory Weight, and therefore Factory Weight is $\frac{10}{11}$ of Bazaar Weight.

$1\frac{1}{2}$ Factory Maunds = 1 cwt. 30 Factory Maunds = 1 ton.

Madras.

	1 tola (or 1 rupee weight)	say	180	grains or ·0257 Av. lb.
3 tolas	= 1 pollam	,,	$1\frac{1}{5}$	Troy oz. or $\frac{3}{40}$,,
40 pollams	= 1 vis	,,	3	Avoir pounds.
8 vis	= 1 maund	,,	25	,,
20 maund	= 1 candy	,,	500	,,

Thus the Madras maund is less than $\frac{1}{3}$ of the Bengal maund. To convert pounds to kilograms ÷ 2 and deduct 10 per cent.

Bombay.

The ser and maund are about $\frac{1}{3}$ of the Bengal ser and maund, but the maund is now taken as equal to 28 lbs., or $\frac{1}{4}$ cwt., and the candy as 560 lbs. or 5 cwt. = $\frac{1}{4}$ ton. But 25 Metric pounds and the Metric $\frac{1}{4}$-ton are nearer the values of the original maund and candy.

Burma.

Principal Units, the bai, tical and viss, respectively approximate to the **gram, 15 grams**, and **1½ kilograms.**

Small Weights.

	1 small ruay or yooway	say	2	grains or $\frac{1}{8}$ gram.
2 small ruays	= 1 large ruay	,,	4	,, ,, $\frac{1}{4}$,,
4 large ruays	= 1 bai, pai or anna	,,	$15\frac{3}{4}$	,, ,, 1 ,,
2 bai	= 1 moo	,,	$31\frac{1}{2}$	,, ,, 2 ,,
2 moos	= 1 mat	,,	63	,, ,, 4 ,,
4 mats	= 1 tical or kyat	,,	$\frac{1}{2}$ Troy oz. or 15 to 16 grams.	

Large Weight.

100 ticals = 1 viss or piakthah say $3\frac{1}{2}$ Av. lbs. or **1½ kilogram.**

MEASURES OF CAPACITY.

Basis :—The Ser, which is supposed to be 1 ser weight of water; and the ser weight being approximately equal to 1 kilogram, the average ser measure may be taken as 1 Liter, as in the ungazetted Act of 1871.

Names of measures of capacity are often, therefore, names of weights.

Bengal Liquid Measures.

5 sicca R's. weight	=	1 chittack	say	⅛ pint	or 7 centiliters.	
4 chittacks	=	1 powah	„	½ pint / ·061 gal.	„ 28	„
4 powahs	=	1 ser	„	¼ gal.	„ 1 1/10	liter.
5 sers	=	1 pali	„	1¼ gals.	„ 5½	„
8 pali or 40 sers	=	1 maund	„	9·81 gals.	„ 44·6	„

Madras.

		1 olak	say	8 c. in	or	¼ pt. nly.	or 13	centiliters.
12¼ olaks	=	1 padi or puddee	say	100 c. in	or	2·88 pts.	or 1·64	liters.
8 padi	=	1 mercal	„	800	„	„ 2·88 gals.	„ 13·1	liters.
5 mercal	=	1 para or parah	„	4,000	„	„ 14½	„ „ 65	liters.
80 para	=	1 gas	„	185·2 c. ft. / 6·86 c. yds.	or 1,154	gals. or 5¼	kiloliters.	

A liter is a cu. decimeter.)

Bombay.

		1 ser	say	49 c. in	or	·18 gals.	or ·818	liter.	
4 ser	=	1 paili	„	197	„	„ ·71	„ „	3¾	„
16 paili	=	1 para	„	3,145	„	„ 11·34	„ „	51½	„
para	=	1 candy	„	14½	c. ft.	„ 90¾	„ „	412½	„

Burma.

The Imperial measures are replacing the native ones in the Towns. (For conversion into Metric quantities, divide by 2 and deduct 10 per cent. = dekaliters. Bushels should be by weight.)

		1 lamyet	or	gill.
4 lamyets	=	1 salay	„	pint.
8 salays	=	1 sah *	„	gallon.
2 sahs	=	1 saik	„	peck.
4 saiks	=	1 teng †	„	bushel.
100 teng	=	1 coyan.	„	100 bushels ($12\frac{1}{2}$ qrs.)

MONEY IN BRITISH INDIA.

(Similar coinage is also supplied the Native States by request.)

		1 pie,	P	=	$\frac{1}{12}$d.
3 pie	=	1 pice,	Ps	=	$\frac{1}{4}$d.
4 pice	=	1 anna,	A	=	1d.
16 annas	=	1 rupee,	R	=	1s. 4d.
$7\frac{1}{2}$ rupees	=	1 half-sovereign			10s. 0d.
15 „	=	1 Pound Sterling	£	=	£1 0s. 0d.

By Act 8 of 1893 the Indian mints were closed to the free coinage of silver, but up to 1899 the *par* value of the rupee remained at 2s. 0d., with an *exchange* value considerably less and fluctuating. But by Act 22 of 1899,‡ the British sovereign was made legal tender concurrent with the rupee, at the exchange of 15 rupees to the sovereign; the rupee is thus rated at 1s. 4d., and $1\frac{1}{2}$ rupees at one-tenth of a pound.§ The Rupee is the Money of Account.

* Or zayoot. † Or basket.

‡ See also Act 19 of 1899, as amended by Act 7 of 1900.

§ $1\frac{1}{2}$ rupees = 96 pice, and 1 sovereign = 960 pice. If India ever has a decimal coinage, it will most probably be by first introducing a $1\frac{1}{2}$ rupee-piece, and subsequently increasing the number of pice to 1,000 and 100 for the sovereign, and $1\frac{1}{2}$ rupee respectively. Or the centesimal division of the rupee may be adopted as in the Colony of Ceylon.

A lac of rupees is 100,000 = £6,666, and a Crore is 100 lacs (⅔ rds. of one million pounds sterling).

The standard fineness of the gold and silver coins is $\frac{11}{12}$ pure metal to $\frac{1}{12}$ alloy. For gold this is the same as the Imperial standard, but for silver $\frac{1}{120}$ inferior. *

Both Gold and Silver are legal tender for any amount †; the legal tender of copper coins is limited to 5 rupees (Act 23 of 1870, sec. 14.)

Paper Currency :—The Department of Paper Currency issues Promissory Notes of the Government of India, payable to bearer on demand, for amounts not less than 5 rupees (=80 pence), to be exchanged for current silver coin, and also, by Act 22 of 1899, sec. 3, gold coin.

Coins in Circulation :—

Gold :— The British sovereign.
" " half-sovereign.
The obsolete Mohur, of 15 former rupees, 180 grains, sterling value £1 9s. 2½d.
Also the Old 5, 10, and 30 rupee-pieces.

Silver :— The Rupee, also of 180 grains (heavier than the British Florin †).
8-anna-piece, 4-anna-piece, 2-anna-piece ; anna.

Bronze :—2-pice-piece of 200 grains,‡ 1-pice, ½-pice.
1 pie.

Cowries :—These small shells are sometimes used in the Native States for small exchanges, about 400 being given for an Anna. In Ceylon, the Rupee is divided centesimally.

* See Footnote, page 94.

† Silver is **not** merely "token" money in India in the same way as it is in England.

‡ The weight of the smaller coins is proportionate, which is not the case with British bronze coins ; see page 94.

MEASURES OF TIME.

(See note on Babylonian system, next page.)

Indian.

	1 antipal	=	·006	second.
60 antipalas	= 1 vipal	=	·4	„
10 vipalas	= 1 pran	=	4	seconds.
6 prans	= 1 pul	=	24	„
60 puls	= 1 ghurri or durdo	=	24	minutes.
60 ghurries	= 1 deen * or day	=	24	hours.

7 deens	= 1 hafta	=	1 week.
15 deens	= 1 pukkho	=	15 days.
2 pukkhos	= 1 maus	=	1 month of 30 days.
2 maus	= 1 rittoo	=	60 days.
6 rittoos	= 1 butsar	=	1 Indian year of "360" days.
12 butsars	= 1 jong	=	4,320 days or 9 weeks short of 12 years.

Hindoo Astronomical Measures.

	1 matra or twinkle	=	·213	second.
15 matras	= 1 kashta	=	3·2	seconds.
30 kashtas	= 1 kala	=	1 m.	36 secs.
30 kalas	= 1 mahurta	=	48	minutes.
30 mahurtas	= 1 day and night of mortals	=	24	hours.
30 days	= 1 month of mortals.			
12 months	= 1 Hindoo year of 360 days.			

* In Bengal, the deen or day is divided into 8 prohors or watches of 3 hours, 1 prohur being equal to 7½ ghurries.

ANGULAR OR CIRCULAR MEASURES, or MEASURES OF SPACE.

			1 second $''$
60	seconds	=	1 minute $'$
60	minutes	=	1 degree $^{\circ}$
30	degrees	=	1 sign (*compare Sign of Zodiac, p.* 219).
45	,,	=	1 octant
60	,,	=	1 sextant
90	,,	=	1 quadrant or right angle
180	,,	=	1 semi-circle
360	,,	=	1 circle ⊙

○ is the symbol for circumference.

The Sun passes over 360° in 24 hours.
15° ,, 1 ,,
1° ,, 4 minutes.

The application of Circular Measure to the Globe is given on page 215, but the French divide the circle into 4 quadrants of 100 degrees each.

A French or centesimal degree on the Earth's surface would therefore represent 100 kilometers, and a centesimal minute would represent 1 kilometer, with the same precision as the sexagesimal minute corresponds with the geographical, nautical, and Admiralty knots (see page 42). Thus, in nautical calculations the unit of length, the unit of angle, and the unit of speed would have a simple relationship.

MEASURES OF TIME

AND THE EARTH'S MOTION IN SPACE.

In Babylonian days (B.C. 2200) the entire system of measurement (Time, Weights, Measures, Coinage, Circle divisions, and Signs of the Zodiac) was based on the great astronomical number 360, on the supposition that the Earth's year was exactly 360 days. This fundamental number was divided into sixties, and these sixties were divided into Tens, the number Ten being the root of notation and numeration.* This ancient system is traceable to-day not only in our present system of time, but in the systems peculiar to India shown on the previous page.

* Compare these numbers with those employed in the designs of Druidical (?) and other ancient edifices, which are believed to have been used for the worship and study of the celestial bodies, and hence the apportionment of "time." In the

TABLE.

			1 second, *s.*
	60 seconds	=	1 minute, *m.*
	60 minutes	=	1 hour, *hr.*
	24 hours	=	1 civil day, *d.*
	7 days	=	1 week, *wk.*
	28 „	=	1 (so called) lunar month,* *l. mo.*
28, 29, 30, or 31	„	=	1 calendar or solar month, *cal. mo.*
	12 cal. months		
	or 13 l. mo., 1 d.		
	or 52 wks. 1 d.		
	or 365 days	=	1 ordinary civil year, *yr.*
	366 „	=	1 leap year, *l. yr.*
	100 years	=	1 century

By the *Julian* calendar, every year whose number was divisible by 4 was a leap year, but by the *Gregorian correction*, exceptions are made to this rule every 100th year, unless divisible by 400.*

The *Gregorian* or N.S. (new style) is 12 days faster than O.S. (old style), September 2nd, 1752, being reckoned as September 14th. In Russia O.S. is still used.

Old Testament chronology dates back to	B.C. 4004
Christ born, according to Roman history	B.C. 4
Next January 1st commences	A.D. 1905
Jewish year commencing September 10, A.D. 1904	= 5665
Mahommedan year commencing March 18, A.D. 1904	= 1322

The length of the day is double the time when the sun sets.
„ „ „ night „ „ „ „ rises.

A.M. is before mid-day. P.M. is after mid-day.

Inst. = the present month; *ult.*, the month immediately past; *prox.*, the next month.

THE CALENDAR MONTHS.

1 January	31	4 April	30	7 July	31	10 October	31
2 February	28 or 29	5 May	31	8 August	31	11 November	30
3 March	31	6 June	30	9 September	30	12 December	31

middle were 12 or 10 blocks of stone (6 or 5 trilithons), generally surrounded by two cromlechs, usually circular but sometimes elliptic, and marked out with 360, 90, 60 or 30, and occasionally 100 stones. At Stennis the circles are about 360 Roman ft., and 100 Roman ft. in diameter. Some of the stones were pierced, apparently for the purpose of observation.

* See page 173.

These can be committed to memory as follows :—

Thirty days have September,
April, June, and November;
February has twenty-eight alone,
And all the rest have thirty-one,
Except in leap year, at which time,
February's days are twenty-nine.

For Mental Date Calculating, see page 199.

For Table for finding number of Days, from any Day of any one Month to the same day of any other Month, see page 202.

For Table for converting any number of Days into Decimal parts of a Year, see page 203.

For the SEASONS see page 219.

STATUTORY QUARTER DAYS.

In England, these are Lady-day, March 25th ; Midsummer, June 24th ; Michaelmas, September 29th ; Christmas, December 25th.

In Scotland they are Candlemas, February 2nd ; Whitsun, May 15th ; Lammas, August 1st ; and Martinmas, November 11th.

Quarterly settlements are then made : most other arrangements are by the week.

In the Colonies, however, rents, wages, &c., are generally by the calendar month, and this is a much better system, because neither English nor Scotch Quarter Days coincide with the changes of the Seasons (see page 219), the Quarters overlap the Years, none expire on the last day of the month, they are of unequal length and one Quarter Day falls on a Bank Holiday. Thus Xmas to L. Day = 90 days (leap year 91) ; L. Day to Midsr. = 91 days ; Midsr. to Michs. = "97" days ; and Michs. to Xmas. = "87" days. Banks balance up monthly to the last day of the month.

MEASURE OF THE EARTH'S MOTION IN SPACE.

(Various Days, Months, and Years.*)

The Solar day† is the interval between two successive passages of the Sun over the meridian of a given place. This interval varies in length (1) owing to the Earth moving round the Sun in an

* See also Antipodes Day, page 176, Shortest Day, page 219, Hindoo Astronomical Time and Indian Time, page 168.

† Also called the "Astronomical day" ; it begins and ends at Noon.

Ellipse, instead of a Circle, and the Sun not being in the centre but at one of the foci, causing the Earth to move quicker through space in Perihelion than in Aphelion, and (2) because the Sun's path does not travel due East and West, *i.e.*, the Thermal Equator and the Equator are not identical, owing to the earth revolving round the Sun, with its axis not at right angles to the ecliptic. In plain language, as Midwinter (North of the Equator) approaches, the Sun's path daily moves more Southwards and as Midsummer approaches more Northwards.

During a solar Day, the Earth revolves on its axis nearly one degree $\left(\frac{360}{365\frac{1}{4}}\right)$ more than 360°, owing to the amount of its movement in its revolution round the Sun, which is nearly one degree per day $\left(\frac{360}{365\frac{1}{4}}\right)$

The Sidereal day is the interval between two passages of a star over the same meridian, which interval only requires the Earth to revolve exactly 360° on its axis (owing to the distance of the stars being so far greater than that of the Sun's). This period is called a sidereal day, and sidereal days must necessarily be of invariable length, and there must be one more day in a sidereal year than in a solar year; the length of a sidereal day is therefore 23h. 56m. 4s. of a common or civil day. A sidereal day, like a solar or astronomical day, commences at noon,* and is divided into the same number of hours, minutes, and seconds as the civil day.

The Civil day of 24 hours is merely an arbitrary division of time, being of equal duration to a "mean" solar or astronomical day. The difference between the solar and civil day is known as the 'Equation of time" (for causes see "Solar day" above), and the Sun† is spoken of in Almanacs as being "before" or "after" the clock. A civil day begins and ends at midnight.

A Julian year is 365d., 6h.

A Gregorian or **Solar** or **Tropical year** at the present time is 365d., 5h., 48m., 45·5ıs., during which time the earth describes 360°—50·22″ to return to the same position in relation to the

* Hence the ancient expression, "the evening and the morning" were the first day.

† The sundial would be the same.

Equinoxes. The Gregorian correction of leap years still leaves a small difference between the tropical year and the average length of the civil year, amounting to 1d., 5h., 26m. in 4,000 years.

A Sidereal year is about 20m. 20s. longer than the tropical year, the Earth describing 360° to return to the same position in relation to both the sun and stars.

An Anomalistic year is 4½m. longer than the sidereal year, or about 25m. longer than a Tropical year, the Earth describing 360° + 11·25″ to return to the same position in perigree.

A Synodic year is a term seldom used; it consists of nearly 354d., 9h., or 12 **synodic or lunar months** at present each of 29d 12h. 44m. 2·7s., during which period the moon describes 360° + 27° to return to the same position in relation to the Earth and Sun, *i.e.*, between consecutive New Moons; a synodic month is, therefore, equal to a *lunation*.

A Sidereal month consists of 27d. 7h. 43m. 11·5s., during which period the moon describes 360° to return to the same position in relation to the Earth and Stars.

A Lunar month is popularly taken at about a mean between the two last-defined periods, namely at 28 days.

For further information on sidereal, solar, and lunar times, consult mathematical works on astronomy.

STANDARD TIME, OR THE SYNCHRONISING OF THE MINUTE HAND OF THE CLOCK THROUGHOUT THE WORLD.

We have already seen on the previous page that the "Civil Day" is a convenient measure of time, fixed arbitrarily by man, and that it can be made to begin and end at any time before or after the solar day.

DEFINITION OF STANDARD TIME:—Standard Time is such that it is either identical with, or different one or more *whole* hours from, "Mean Greenwich" time.

Therefore, when it is adopted universally, whatever part of the world a clock, showing correct time, is in, its minute and second hands will agree with local, Greenwich, and all other times. This is not a matter of maudlin sentiment, but of strict Business, being absolutely indispensable for Railway, Telegraphic and Telephonic communications and appointments.

As the Earth revolves in space, the Sun passes over 360° of its

surface in 24 hours, 15° in 1 hour, and 1° in 4 minutes. When convenient areas are mapped out, regard must therefore be had to the governing meridians of 0°, 15°, 30°, 45°, 60°, and so on; but these meridians need not be followed exactly, as is illustrated by comparison of the specially prepared Map of Africa with the Table on page 224.

Over half a century ago, an eminent Russian Astronomer said the whole world would soon set their clocks by Greenwich. Let us see how far he has been right.

Standard time is adopted throughout England, that is to say "Mean Greenwich" time, which is 7 minutes slow of actual Lowestoft time, and 15 minutes fast of actual Land's End time.

France, Belgium, Holland, and Spain either adopt, or are in the course of adopting, the same time as England.

Germany, Austria, Italy, Switzerland, Denmark, and Norway, lying between 5° and 27° East of Greenwich, have adopted "Mid-European" time, which is 15th E. Meridian time, 1 hour fast of Greenwich.

The whole of British South Africa, Egypt, and Turkey use 30th E. Meridian time, or 2 hours fast of Greenwich.

In Adelaide the clocks are "9½" hours ahead, but elsewhere, Australian time is either 8, 9, or 10 hours fast of Greenwich.

In Japan 135th E. Meridian time is adopted, being 9 hours fast of Greenwich.

In the Western World, Canada and the United States also use Standard Time as follows:—

60th W. Meridian, or	"Eastern Time"	4 hours			
75th " "	"Atlantic Time"	5 "			
90th " "	"Central Mississippi" or "Valley" Time	6 "			
105th " "	"Mountain Time" ...	7 "			
120th " "	"Pacific Time"	8 "			

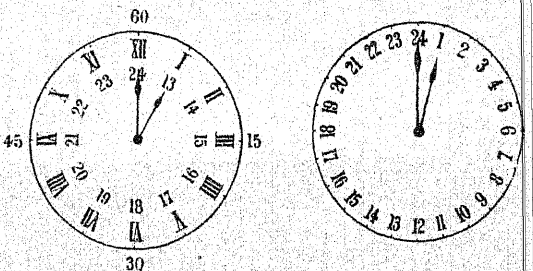
"Slow" of Greenwich.

Clock Charts and Geographies showing exact Longitudinal as distinct from Standard time are therefore generally wrong.

In Ireland, however, Dublin time, 25 minutes 22 seconds fast of Greenwich, is used, although Mid-Ireland is 7½° West of Greenwich, equal to one half-hour of time. One would certainly think that this latter "Semi-Standard" time even would be preferable to a purely local time.

A Small Defect.

"Standard Time" leaves one small defect. Thus we can imagine in the future the Premier of Canada saying to the Premier of South Africa, "Meet me again on the telephone at 11 o'clock to-morrow morning, my time," meaning 11 a.m. in Canada and 6 p.m. in South Africa; and we can also imagine the S.A. Premier keeping the appointment at 6 a.m. by mistake, and ringing up the Canadian Premier at 11 p.m. If it is wished to obviate this kind of error, the clock dial should be divided into 24 hours, as in Spain, where the use of the letters a.m. and p.m. is avoided. There are two ways of doing this:—



A NEW IDEA FOR CABLEGRAMS.

To obviate the paradox of receiving a cablegram at an earlier hour than it was sent, or any inconvenience in ascertaining how long it had been delayed in transmission, the 24 time-divisions of the globe could be each allotted one of the 26 letters of the alphabet, omitting *j* and *w*, which letter could be printed on the cablegram forms.

Starting with *a* for the division 12 hours fast of Greenwich, *i.e.*, "where Day begins," and proceeding Westwards, actual Greenwich time would be *l* time; 75th W. Meridian Time (called Atlantic Time in the United States), being 5 hours slow of Greenwich, would be "*q* time"; and so on.

Thus, if a cable were sent from Johannesburg (*i*) to Montreal (*q*), by cabling the letter *i* after the time the message was handed in, the recipient would see almost at a glance that to the time it had apparently taken to reach him he must add 7 hours, because there are 7 letters in between *i* and *q* (omitting *j*).

ANTIPODES DAY.

A curious difficulty regarding the days of the week on the 180th Meridian may be here noticed.

180° E. of Greenwich should be 12 hours fast on Greenwich.
180° W. „ „ „ 12 „ slow „ „

But these two points coincide, and the question arises what should be the day of the week on the 180th Meridian.

Fortunately, this Meridian falls almost entirely across the ocean,* and mainly affects ships passing over it. To overcome the error, which would otherwise be introduced, in the days of the week, in their calendars, with reference to the days of the week at Greenwich, ships crossing the Meridian going West skip one day of that week, and ships travelling East have one day of that week twice over.

Thus a ship crossing the 180th Meridian, going West, say on Thursday, October 15, would put in its Diary, "Antipodes Day (Thursday and Friday, October 15 and 16)"; and one passing Eastwards would insert *a dateless day*, also called "Antipodes Day."

This adjustment was first found necessary by the Spanish navigators of Magellan's expedition, who made the first journey round the World, sailing Westwards, and arrived in the harbour of San Lucar on September 7, 1522, but according to the ship's record on September 6th.

As a set-off against the loss or gain, as the case may be, ships travelling Westwards put time back 1 hour every 15° long., and thus have days of *more* than 24 hours' duration, and those going Eastwards put the clock on 1 hour every 15° long., and so have days of *less* than 24 hours. The corrections are made by the sun at noon each day.

* This fact has made the Meridian of Greenwich particularly suitable as the starting Meridian for all countries.

SHIP'S TIME, &c.

Under the last heading, certain eccentricities in Ship's Time have already been noticed, but before passing on to the peculiar system of count adopted for time on board ship, it should be remarked that the difference, if any, between actual time and Standard Time, is usually remedied immediately a ship passes beyond the 3-mile limit, instead of waiting until noon of the next day.

Bells and Watches.

A ship's day commences at noon, and is divided into five watches of four hours each, and two short or *dog* watches of two hours each, the latter enabling the men to shift the hours of their duties, from day to day.

At 1 bell, the bell is struck once, which denotes one *half-hour* has passed since the watch was mounted; at 2 bells twice, at an interval of a second, denoting one hour; 3 bells, twice at an interval of one second and once again after an interval of two seconds; 4 bells, twice at an interval of one second, an interval of two seconds, and twice again at an interval of one second; and so on.

Afternoon Watch	Noon to 4 p.m.
First Dog "	4 p.m. to 6 p.m.
Second Dog "	6 p.m. to 8 p.m.
First Watch	8 p.m. to midn't.
Middle "	midn't. to 4 a.m.
Morning "	4 a.m. to 8 a.m.
Forenoon "	8 a.m. to noon.

Fire alarm; the bell is struck many times in quick succession.

Port and Starboard: Windward and Leeward.

The Port side of a ship is the Left and carries a Red Light.
" Starboard " " Right " Green "

This can be remembered as follows: If the steward drinks the *Red Port* that is *Left*, he will soon see *Green Stars* al*Right*.

Windward is the Point from which the wind blows, and Leeward is the point towards which the wind blows.

THE COMPASS AND MAGNETISM.

THE COMPASS.

The four Cardinal points of the Compass are North, South, East, and West.

New Style (Decimal).

The modern way of dividing the dial is into degrees, and most men at the wheel prefer the course laid in this way. The system is adopted in our up-to-date Navy. There are several methods of so showing the degrees. Mariners start both the North and South points at 0°, and continue round to 90° at East and West. Compasses for small yachts, &c., usually start at 0° at the North point and continue round both ways (by two concentric circles of figures) until the North point is again reached, namely, 360°. Surveyors and others sometimes start the North Point at 0°, and continue round by the East and West to 180° at the South point.

Old Style (Binary).

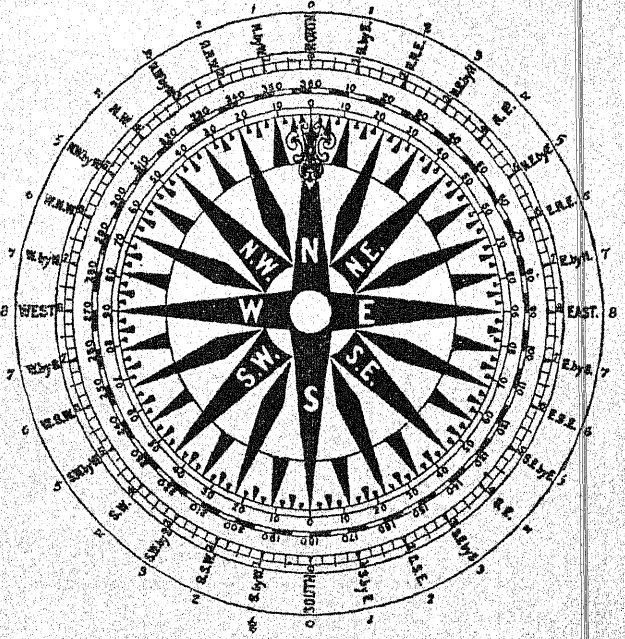
The older method of dividing the circle into 32 points of 11¼° each, namely, 8 points in each quadrant, is now used only by some Mariners. Each point is again subdivided into quarter-points of 2° 48′ 45″. But on such compasses, the division of each quadrant into 90° is also now shown.

The 32 points are thus denoted :—

Pts.	Angle.				
	° ′ 0 0	North.		South.	
1	11 15	N. by E.	N. by W.	S. by E.	S. by W.
2	22 30	N.N.E.	N.N.W.	S.S.E.	S.S.W.
3	33 45	N.E. by N.	N.W. by N.	S.E. by S.	S.W. by S.
4	45	N.E.	N.W.	S.E.	S.W.
5	56 15	N.E. by E.	N.W. by W.	S.E. by E.	S.W. by W.
6	67 30	E.N.E.	W.N.W.	E.S.E.	W.S.W.
7	78 45	E by N.	W. by N.	E. by S.	W. by S.
	90	E.	W.	E.	W.

W.N.W.¼W. would mean 2° 48′ 45″ more to the westward than W.N.W.

N. by W.½N. would mean 5° 37½′ West of the North point, and could also be styled ½ point West of North.



Above is a specially designed comparison dial showing the different methods of dividing the circle into 360°, or four quadrants of 90°, or 4 quadrants each of 8 points and 32 quarter-points. It is produced here by the kind permission of Messrs. H. Hughes & Son, Opticians, 59, Fenchurch Street, London, E.C.

Few compasses of course would show all the methods. A diagram showing only the new style of compass appears in the "Beginners' Up-to-date Table-Book."

The French divide the circle into 4 quadrants of 100 degrees each (see page 169).

MAGNETISM.

The Earth is a Magnet, but neither of the two ends of the magnet coincide with the "True" or "Astronomical" Poles, and the line joining the "Magnetic Poles" does not pass through the Earth's centre.

In 1830, the North Magnetic Pole was situate about 95° West long., and 70° North lat. (John Ross), and the South Magnetic Pole about 168° East and 75° South.

Therefore, no "Magnetic Meridians" or lines of force can coincide with the Astronomical lines of Longitude, neither can there (at the same time) be more than one magnetic meridian, in each half of the globe, which is true North and South; and at different positions on the Earth's surface the magnetic needle must necessarily make varying angles with the true North and South. This difference of angles is known as "Variation."

Anywhere East of the North Magnetic Pole, the variation must decrease as we travel Westwards and Southwards.

The Magnetic Poles are moreover continually on the move, oscillating, in the course of centuries, Eastwards and Westwards, in pendulum fashion, causing a change known as "Declination."

The combination of variation and declination for a given locality is, therefore, always on the increase or decrease. There is also a small diurnal declination; at Greenwich, in the winter, it is a little less than 10′, and in the summer a little more.

The mean combined factors of variation and declination cause the Magnetic needle at Greenwich to be at present 16° 17′ West of North. This angle is now slowly decreasing.

In addition to the horizontal movements, there is also a vertical movement known as the "Dip" or "Inclination," and this also differs at various points of the Globe, and is subject to both secular and diurnal charges. Half-way between the Magnetic Poles, *i.e.*, at the "Magnetic Equator" (a plane adjacent to the terrestrial Equator) the dip does not exist, but it begins the moment we depart from this line, until at the poles the needle would be actually at right angles to the Earth's surface. At Greenwich the mean dip is now about 67°.

Apart also from the secular and diurnal changes, and changes through the position on the Earth's surface, there are changes according to the electrical state of the atmosphere, season of the year, state of sun-spots, &c., which are not yet entirely understood, and for the studying of which, Observatories are established throughout the world. "Artificial" disturbances are caused by Electric Trams, &c.

Table of Mean Values, for the years specified, of Magnetic Elements in various parts of the Empire.*

Place.	Latitude.	Longitude.	Year.	Declination.	Inclination.
	° ′	° ′		° ′	° ′
Greenwich	51 28 N.	0 0	1903 1900	16 17 W.	67 8·5 N.
St. Helier (Jersey) ...	49 12 N.	2 5 W.	1901	16 56·5 W.	65 42·7 N.
Agincourt (Toronto)	43 47 N.	79 18 W.	1900	5 28·8 W.	74 32·5 N.
Hong Kong	22 18 N.	114 10 E.	1900	0 18·5 E.	31 24·7 N.
Colaba (Bombay ...	18 54 N.	72 49 E.	1899	0 25·4 E.	21 13·9 N.
Cape Town	33 54 S.	18 23 E.	1900	28 53·0 W.	— S.
Melbourne	37 50 S.	144 58 E.	1898	8 20·1 E.	67 22·4 S.

* From information kindly furnished by the National Physical Laboratory, Bushy Park, Teddington, and the Royal Observatories at Greenwich and Cape Town.

WATER.

Weights and Measures.

Pure water is the STANDARD USED FOR SPECIFIC GRAVITIES (see next page); its s.g. is therefore 1.

1 cubic decimeter of water = 1 liter = 1,000 grams or 1 kilogram.*

·00396 c. in. water = 1 grain.

1 c. in. = 252·286 grains = ·03604 lbs. water = ·003604 gals.; will form a little more than 1 c. ft. of steam.

277·463 c. in. = ·16 c. ft. = 1 gallon = 8 pints = 10 lbs. water.†

1 c. ft. = 62·2786 lbs. ‡ (or nearly 1,000 Avoir. ozs.), say, 6¼ gals.

Supply in London per head from 20 to 30 gals. daily.

1 cu. meter = 1 kiloliter = 1 Metric ton.*

1 c. yd. or 27 c. ft. = about 170 gals. = 15 cwt. or ¾ long ton.

32 c. ft. = 200 gals. = 1 short ton.

34·3863 c. ft. Salt Water = 1 Metric Ton or 2,204½ Avoir. lbs.

34·937 c. ft. „ = 1 Impl. Ton or 2,240 „

35·3148 c. ft. or 1 cu. meter Fresh Water = 1 Metric Ton or 1,000 kilogs.

35·88 c. ft. Fresh water = 1 Impl. Ton or 1,016 kilogs.

A Tank 4 ft. cubed § (64 c. ft.) holds 400 gals. water = 4,000 lbs. = 2 short tons.

Temperatures and Densities.

Water boils at 100° Cent., 212° Fahr., 80° Réaumur.

Fresh Water freezes at Zero in Cent., and Réaumur; 32° Fahr.

Sea water freezes at 27° Fahr.

Greatest density of fresh water, 4° Cent., 40° Fahr.

„ „ sea „ 0° Cent., 32° Fahr.

Sea water = 1·027 weight of pure water.

Pure water = ·973 sea water.

Ice, 4 centimeters or 1½ in. thick will support a man.

1 c. ft. of ice = 57·8 lbs.

---

* Hence the vast superiority of the Metric System: compare the complex figures which follow.

† Rhyme: "A pint of pure water
Weighs a pound and a quarter."

‡ Board of Trade Standards Department, 1890; at 62° F., Mercury 30 inches.

§ A size often used for exporting goods into the Colonies.

Soft and Hard Water.

Metric method: 100 milligrams (= 1 decigram) of bicarbonate or sulphate of lime per liter is considered "soft" water. Above this amount is considered "hard." *

English method :—

1 degree of hardness implies a little more than 1 grain per gal.

Under 6 degrees of hardness = soft water.

Over 6 „ „ = hard „

Soft water is the most economical for steam-power, washing, tea, &c.

Rainfalls.

Maximum rainfall per minute in England, 9 millimeters or ·355 in.

Maximum rainfall per day in England, 75 millimeters or 3 in.

Mean annual rainfall in West of England, about 1 meter or 40 in.

In South Africa a little more than ½ this quantity generally falls.

In Australia „ „ ¾ „ „

In Indian Plains about 1½ „ „

In Indian Hills „ 4 „ „

25 millimeters rainfall = 250 Metric tons per Hektar.*

1 in. rainfall = about 101 long tons per Acre.

„ „ = „ 214 „ or 240 short tons per Morgen.

Water and Air.

Water is 830 times heavier than Air.

Cubic meter of Air contains on an average 8·7 grams water.

„ foot „ „ „ 3·8 grains „

Water covers but little less than ¾ surface of the Globe.

Light penetrates not more than about 200 meters or 700 feet into water.

SPECIFIC GRAVITY OR COMPARATIVE DENSITY.

Definition :—

Specific Gravity is the relation between the weights, at a fixed temperature, of any body, liquid, or gas, and that of an equal bulk of some other body, liquid, or gas, taken as a standard.

---

* Another example of the extreme simplicity of the Metric System.

Examples:

The standard for solids and liquids is distilled water at its greatest density (nearly 4° Cent., or 39·2° Fahr.).

The standard for gases is either Air or Hydrogen.

Water at its greatest density is therefore reckoned as 1.

A body weighs lighter in water than in air.

Its Specific Gravity is shown by the amount of water it displaces when floating.

If a substance is too heavy to float, to obtain its specific gravity we must place it on something large enough to float it (for which allowance must afterwards be made).

The heavier it is, the more water it will thus displace. A floating body weighs nothing in water; in air it would weigh equal to the weight of water it displaces.

The specific gravity of liquids is obtained by placing them in a floating vessel, the weight of which must be allowed for.

British Weights and Measures:—

1 cubic foot of water at 39·2 degrees weighs about 1,000 ozs. (997·136); therefore the weight, in ounces, of a cubic foot of any substance also approximately denotes "1,000 times" its specific gravity.*

Metric Weights and Measures:—

One cubic centimeter of water at 4° Cent. weighs 1 gram, therefore the weight, in grams, of a cubic centimeter of any substance also denotes its specific gravity.*

The superiority of the Metric System is here shown; and the weights and measures are so related that they ascend step by step in regular order, so that 1 cubic meter of water weighs 1 metric ton, and so on.

This gives a far greater value to slide-rules than is the case with the unscientific Imperial measures. Most slide-rules have the specific gravities of ordinary substances shown on them.

Formulæ:—

Volume or bulk × specific gravity = weight.
Weight ÷ specific gravity = volume or bulk.

---

* Likewise, if we know the volume of a substance and its specific gravity, we can find its weight.

The following comparisons, water being 1, are given for shipping and other commercial purposes :—

DRY TIMBER.

Poplar	·4	Mahogany ...	·56 to ·85
Pine, white ...	·43 to ·55	Teak	·74 to ·86
„ yellow ...	·5	Sycamore ...	·68
„ red ...	·57 to ·65	Ash	·7
Willow ...	·53	Oak	·77 to ·98
Fir, spruce ...	·5	Satinwood ...	·96
„ Scotch ...	·55	Ironwood ...	1·15
„ larch ...	·55	Ebony	1·2
Elm	·55	Lignum vitæ ...	1·33

Fresh felled ash and willow are over $\frac{1}{5}$ as heavy again, oak and fir over $\frac{1}{2}$, elm about $\frac{3}{4}$, and poplar about $2\frac{1}{2}$.

MISCELLANEOUS SUBSTANCES (approximately).

Coal	$1\frac{1}{4}$ to $1\frac{1}{2}$	Limestone ...	2 to $2\frac{1}{2}$
Shingle	$1\frac{1}{2}$	Oolite	2 to $2\frac{1}{2}$
Sand	$1\frac{1}{2}$ to $1\frac{3}{4}$	Slate	$2\frac{1}{2}$ to 3
Gravel	$1\frac{3}{4}$	Granite	$2\frac{1}{2}$ to 3
Earth	$1\frac{1}{2}$ to 2	Marble	$2\frac{3}{4}$
Sandstone ...	$1\frac{1}{2}$ to $2\frac{1}{2}$	Glass	$2\frac{1}{2}$ to 3
Bricks	$1\frac{1}{2}$ to 2	Cement	3
Clay	2		

METALS.

Zinc	6·9 to 7	Silver, pure ...	10·5
Tin	7·3	Lead	11·4
Iron	7 to 7·8	Mercury ...	13·6
Steel	8	Gold, standard ...	17·7
Brass	8·5	„ pure ...	19·4
Copper	8·9	Platinum ...	21·5
Silver, standard ...	10·3		

S.g. of sea-water = 1·027.
Pure water = ·973 of sea-water.

MEASURES OF TEMPERATURE.

Thermometers are of three scales: by Celius (Centigrade), Fahrenheit, and Réaumur.

One degree of temperature on a Centigrade scale is greater than a Fahrenheit degree in the ratio of 9 to 5, and is a more convenient size for decimal subdivision. One degree Réaumur is greater than a Centigrade degree in the ratio of 5 to 4.

Freezing-point of water = zero in Cent. and Réaumur = 32° Fahr.*
Boiling-point " = 100° Cent. = 80° Réaumur = 212° "

Zero in Fahrenheit's thermometer is the congelation of sal ammoniac.

"Absolute zero" = 461·2 below zero Fahr.

For converting degrees of temperature from one scale to another, we have the following formula, in which C. represents Centigrade; F. represents Fahrenheit; R. represents Réaumur (minus quantities are below zero):—

$$\frac{C.}{5} = \frac{R.}{4} = \frac{F. - 32}{9}$$

From which may be obtained:—

$$C. = \frac{5\,(F. - 32)}{9} \qquad C. = \frac{5}{4}\,R.$$

$$F. = \frac{9C.}{5} + 32 \quad ; \quad F. = \frac{9R.}{4} + 32$$

$$R. = \frac{4}{5}\,C. \quad ; \quad R. = \frac{4\,(F. - 32)}{8}$$

$$F. = C. + R. + 32.$$

Normal temperature of man = 36·9 Cent. = 98·4 Fahr. = 29·5 Réaumur.

A rise of every 350 feet gives a fall of 1° F. in the average temperature; for a similar fall in summer, the rise would be less, and in winter more.

Centigrade scale is mostly used by engineers.

Fahr. is used in the Clinical thermometers, and the quicker they respond to a change of temperature, the better the manufacture; minute or half-minute thermometers are the best for private use.

Thermometers, barometers, &c., are verified at the Kew Observatory, a department of the National Physical Laboratory, Bushey Park, Teddington.

For legal temperature of standards of weights and measures, see page 116.

* Barometer at 760 millimeters.

BRITISH MEASURES OF POWER AND HEAT.*

One horse power (or 1 H.P.) is a force required to raise 33,000 lbs. 1 vertical foot in one minute.

Indicated horse power in Stationary Engines is from 2½ to 3 nominal horse powers; but in Marine Engines it sometimes amounts to 6 or 7 times the nominal horse power.

A nominal horse power is equal to about 5 men's power, but 5 men will carry 100 lbs. each up a steep hill quicker than a horse would carry 500 lbs.

The British Thermal Unit, or **Unit of Heat,** is the quantity of heat that will raise 1 lb. of pure water, 1° Fahr., at or about a temperature of 39·1° Fahr. (*i.e.*, the maximum density of water).

The Mechanical Equivalent of Heat: The British Thermal Unit is approximately equal to 778 foot-pounds of mechanical work. Therefore 42·4 B.T.U.'s are equal to 1 H.P.

MEASURES OF PRESSURE.*

The Unit of Pressure is usually 1 lb., acting on a surface of 1 sq. in., *i.e.*, 1 lb. per sq. in.

It is sometimes specified in equivalents of feet of water, *i.e.*, the pressure at the bottom of a column of water 1 ft. high.

1 lb. per sq. in. is equivalent to the pressure at the bottom of a column of water 2·309 feet.

It is also specified in inches of Mercury, 1 lb. per sq. in. = 2·035 inches of a Mercury column.

And in some instances it is specified in "atmospheres."

"One Atmosphere" is the pressure of 14·7 lbs. per sq. in. or 34 ft. of water, or 29·92 in. of Mercury.

"The Metric Atmosphere," as used in France, Germany, and Austria, is 1 kilogram per sq. centimeter, and is therefore rather smaller than the above; *i.e.*, it is equivalent to 14·22 (instead of 14·7) lbs. per sq. in., or 28·94 (instead of 29·92) in. of Mercury.

* Metric units are more intelligible owing to the interdependence of the measures and weights. There are no Board of Trade standards (see page 23).

To reduce kilograms per sq. centimeter to lbs. per sq. in. × 14·2228; converse × ·0703095.

The fall in the Barometer accompanying the cyclone in Great Britain on the night of 10th Sept., 1903, was one inch, equal to a reduction in the weight of air of ½ lb. per sq. in., or 1,400 tons per acre.

MEASURES OF ELECTRICITY.

Particulars of the Standard Ohm, Ampère, and Volt, as fixed by the Board of Trade, London, pursuant to the Weights and Measures Act, 1889, section 6, appear in an Order in Council published on pages 4931 to 4933 of the London Gazette, number 26545 and dated 24th August, 1894.

The chief Standards or Units for commercial purposes are the :—

Volt	for the measure of pressure or electromotive force.			
Ohm	,,	,,	,,	,, resistance.
Ampère	,,	,,	,,	,, current, *i.e.*, the current 1 volt will drive through 1 ohm.
Coulomb	,,	,,	,,	,, quantity (= 1 ampère flowing for 1 second of time).
Microfarad	,,	,,	,,	,, capacity.
Watt	,,	,,	,,	,, power (a watt is an ampère × by a volt).

Electrical standards, sub-standards, &c., are deposited with the Electrical Adviser of the Board of Trade, Richmond Terrace, Whitehall. Centigrade scale of temperature is used.

A "Board of Trade Unit" = 1 Kilowatt or 1,000 watts, 1 hour, = about 1⅓ H.P.,* and it will keep a 10-candle incandescent lamp alight for about 25 hours.

Electric Meters are read similarly to Gas Meters.

British Standard Candle-power: A spermaceti candle, ⅞ inch diameter, ⅛ lb. weight, burning at rate of 120 grains per hour.†

---

* 746 watts = 1 H.P.

† Foreign units of light are simpler, because of the metric quantities.

MEASURES OF GAS.

The measure used in testing the illuminating power of gas * is two such candles as above, after burning at least 10 minutes, allowance being made if the rate of burning has differed from the rate of 120 grains per hour (see Sec. 12 and Schedule of the Gas Works Clauses Act, 1871).

The Gas Unit of measure is the cubic foot decimally divided, and containing 62·321 Avoir. lbs. weight of water at 62° Fahr. (Sale of Gas Act, 1859, sec. 33).†

Board of Trade standards or gas holders are of the following denominations: 1, 5, 10, and 20 cubic feet.

Reading an Ordinary Gas-meter:—

The three dials on a gas-meter indicate the quantity of gas that has passed through the meter since it was made, and to find out the quantity of gas consumed since the previous observation, the previous reading should be deducted from the reading shown.

A novice reading a gas-meter might read it just ten times the true meaning.

The right-hand dial is for *hundreds* of feet (but as it registers up to ten hundred, it has "1 Thousand" over it); the middle dial is for *units of thousands* (and similarly has "10 Thousand" over it); the left-hand dial registers *tens of thousands* of feet (and similarly has "100 Thousand" over it).

The outer dials go round the same way as the hands of a watch; the inner dial the reverse way.

Say the reading is 29,900 feet, the left-hand dial will be almost exactly over the 3: be careful not to read it 39,900.

Electricity and Gas.

B.T. Units at 1d. = Gas at 6d. per 1,000.
" " " 2d. = " " 1s. 0d. " "
" " " 6d. = " " 3s. 0d. " "
and so on.

* This is a qualitative rather than a quantitative measure.
† This unit is confirmed by W. and M. Acts of 1878 (sec. 66) and 1889 (sec. 15); but the number of lbs. to the cu. foot is not now considered accurate.

PAPER AND BOOKS.

A FEW SIZES OF WRITING AND DRAWING PAPER.

The sizes vary according to the kind of paper, and according to the maker.

	INCHES.	CENTIMETERS.
Pott	15 × 12½	38 × 32*
Brief	16½ × 13	42 × 33
Foolscap	17 × 13½	43 × 34
†Post	19 × 15¼	48 × 38
†Demy	20 × 15½	51 × 39
Copy or Draft	20 × 16	51 × 41
Large Post	21 × 16½	53 × 42
†Medium	22 × 17½	56 × 44
†Royal	24 × 19	61 × 48
Super-royal	27 × 19	69 × 48
†Imperial	30 × 22	76 × 56
Elephant	28 × 23	71 × 58
Columbier	34½ × 23½	87 × 60
Atlas	34 × 26	86 × 66
Double elephant ...	40 × 27	102 × 68
Antiquarian	53 × 31	134 × 79
Emperor (6 ft. × 4 ft.)	72 × 48	183 × 122

Rolls of tracing cloth are 24 yds. or 22 meters long, and the following widths in inches :—18, 28, 36, 38, and 41 ; in centimeters 46, 71, 91, 96, 104.

Continuous cartridge is 54 and 60 ins. or 137 and 152 centimeters wide.

* It must be borne in mind that if the paper were made in Metric quantities in the first instance, it would most probably cut up into even or half decimeters, instead of into centimeters, and then this column would read in units instead of in tens. For example 69 × 48 would become 7 × 5; 102 × 68 would become 10 × 7, and the sizes would therefore be easier to remember in decimeters than in inches.

† These are also Printing Paper. (See next page.)

PAPER QUANTITIES.

20 sheets	=	1 quire outsides *
24 sheets (perfect)	=	1 quire
25 sheets	=	1 quire, printer's
20 quires	=	1 ream
21½ quires	=	1 ream, printer's
2 reams	=	1 bundle
10 reams	=	1 bale
60 skins	=	1 roll of parchment

PRINTING PAPER.

Those marked † on previous page (in which the printing sizes are slightly larger than the drawing sizes), and the following:

	INCHES.	CENTIMETERS.
Sheet and Half Post	23½ × 19½	60 × 50†
Double foolscap	26½ × 16¾	67 × 43
,, Crown	30 × 20	75 × 50
,, Post	31½ × 19½	80 × 50
,, Demy	35 × 22½	89 × 57
,, Royal	40 × 50	102 × 64

LEGAL FOLIOS.

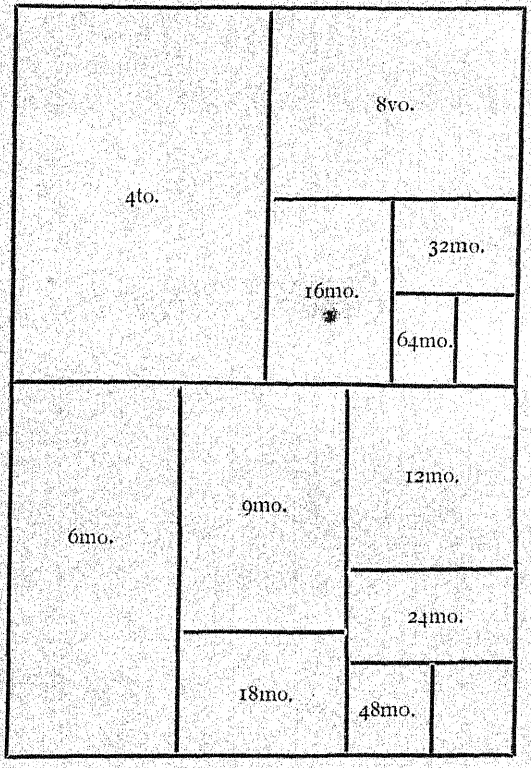
90 words in "Chancery"
80 ,, "Exchequer"
or 72 ,, "Common Law"
} = 1 folio

BOOKS.

	Sheet	Le'vs	P'gs		Sheet	Le'vs	P'gs
Folio Books	1	= 2	or 4	Duodecimo or 12mo.	1	= 12	or 24
Quarto or 4to	1	= 4	,, 8	16mo ...	1	= 16	,, 32
Octavo or 8vo	1	= 8	,, 16	24mo, &c. (*see next page*).			

* Some of these may be torn.
† See first footnote on previous page.

The following illustrates the various foldings of a sheet of paper (the diagram is 1 decimeter by $\frac{2}{3}$ decimeter).



NOTATION AND NUMERATION.

Hundreds of Millions.	Tens of Millions.	Millions (or units of Millions).	Hundreds of Thousands.	Tens of Thousands.	Thousands (or units of Thousands).	Hundreds.	Tens.	Units.	(*Decimal Point*).	Tenths.	Hundredths.	Thousandths.
2	3	5,	8	6	3,	4	7	9	·	5	3	2

Two hundred and thirty-five millions, eight hundred and sixty-three thousand, four hundred and seventy-nine, decimal five three two.

(Divide the figures to the left of the decimal point from the right into groups of three, by commas.)

Arabic Figs.	Roman Figs.	Arabic Figs.	Roman Figs.	Arabic Figs.	Roman Figs.
1	I.	13	XIII.	101	CI.
2	II.	14	XIV.	400	CD.
3	III.	20	XX.	500	D.
4	IV.	21	XXI.	600	DC.
5	V.	30	XXX.	900	CM.
6	VI.	40	XL.	1,000	M.
7	VII.	50	L.	1,001	MI.
8	VIII.	60	LX.	1,100	MC.
9	IX.	70	LXX.	1,899	MDCCCXCIX.
10	X.	80	LXXX.	2,000	MM.
11	XI.	90	XC.	For origin of Arabic figures, see Martin's Beginners' Table-Book.	
12	XII.	100	C.		

One Million is a thousand times a thousand—1,000,000.

A Billion in England is a million times a million.

A Trillion „ „ „ billion.

Abroad a Billion is only two millions, and a trillion only three millions.

COMMERCIAL NUMBERS.

Dozens.		*Scores.*	
12 articles	= 1 dozen	20 articles =	1 score.
13 „	= 1 long dozen	5 score =	1 common hundred.
12 dozen *or* 144 articles	= 1 gross	6 score =	1 long ditto.
12 gross *or* 1,728 „	= 1 great gross		

Metric Countries reckon decimally.

PART II

IMPERIAL AND OTHER INFORMATION USEFUL IN THE OFFICE, WORKSHOP, CLASS-ROOM, RECREATION GROUND AND HOME, AND ON THE FARM.

CALCULATIONS.

To "mentally" convert all sums under £1 into decimal parts of a pound.

Rule :—Immediately after the decimal point put the number of whole florins there are in the amount, and the figures for the next two places of decimals are found by counting every remaining 6d. in the amount as 25, and every farthing in the remainder as 1, but if the number of farthings in the remainder is more than 12, then add 1 more.

Examples :—0s. $8\frac{3}{4}$d. = ·025	5s. $9\frac{3}{4}$d. = ·275
11	15
1	
·036	·291

To multiply two figures by 11, between the two figures write their sum.

$54 \times 11 = 594$. $69 \times 11 = 759$.

To multiply by any number of nines, place as many ciphers to the right of the number as there are nines, and from the result deduct the number.

$$6{,}372 \times 999 = 6{,}372{,}000 - 6{,}372 = 6{,}375{,}628.$$

To multiply by 25, 2,500, &c., place as many ciphers to the right of the number as there are figures in the multiplier, and divide by 4.

$$673 \times 2{,}500 = 6{,}730{,}000 \div 4 = 1{,}682{,}500.$$

Converse :—

To divide by 25, 2,500, &c., multiply by 4 and point off as many figures as there are figures in the divisor.

$673 \div 25 = 26{\cdot}92.$ $\quad$ $4{,}897 \div 2{,}500 = 1{\cdot}9588.$

·92 indicates there is $92 \div 4 = 23$ over.

To multiply by 5, 50, 500, &c., place as many ciphers to the right of the number as there are figures in the multiplier, and divide by 2.

$$479 \times 500 = 479{,}000 \div 2 = 239{,}500.$$

Converse :—

To divide by 5, 50, 500, &c., multiply by 2, and point off as many figures as there are figures in the divisor.

$$479 \div 50 = 9{\cdot}58.$$

To Prove Multiplication ; the rule of Nines.

(1) Add up the figures of the multiplicand, divide by 9 and put down the remainder. (2) Add up the figures of the multiplier, divide by 9, and put down the remainder. (3) Multiply these two remainders together, divide by 9, and put down the remainder.

Then add up the figures in the product, divide by 9, and the remainder should be equal to number (3) remainder.

Thus $84 \times 53 = 4452$.

Proof 8, 4 = 12. 12 ÷ 9 = 3 over. Also 5, 3 = 8. 8 ÷ 9 = 8 over.
3 × 8 = 24. 24 ÷ 9 = 6 over.
4, 4, 5, 2 = 15. 15 ÷ 9 = 6 over.

Again :—457,893 × 20,614 = 9,439,006,302.

0 × 4 = 0.
0 ÷ 9 = 0 over. Product 0 over.

In adding up the figures, we can dispense with the nines as we come to them; thus in the last example, 4 + 5 = 9; begin again at 7 + 8 = 15, miss the 9, 15 + 3 = 18 = 0 over, and so on.

If the last figure of a number is divisible by 2 or 5, the no. itself is.
„ 2 figures „ are „ 4 or 25, „ „
„ 3 figures „ „ „ 8 or 125, „ „
If the sum of the figures of a number is divisible by 3 or 9, the no. itself is.

To find the difference of the Squares of Two numbers, add the numbers together and multiply by their difference.

$374^2 - 59^2 = 433 \times 315 = 136{,}395.$

To multiply two numbers together each ending with a half :—
To the product of the two whole numbers add half their sum and a ¼.

13½ articles at 7 kilograms = 91 + 10 + ½ = 101¼ kilograms.
15½ dekals at 14¼ florins = 210 + 14½ + ¼ = 224¾ florins.

---

* To find the Price of :—

One dozen, the price of one being given :—

Call every penny in the price one shilling, and every farthing three-pence.

12 at 9¼d. = 9s. 3d.

---

* **Note :**—If the Imperial Decimal System of Coinage, &c., were adopted, all such calculations as these would be dispensed with, and the mere altering of the position of the decimal point would be sufficient.
A decimal system also makes the use of Logarithms and Calculating Machines useful in many ways, in which it is now impossible to use them.

To find the price of :—

One score, the price of one being given :—

Call every shilling in the price one pound, and every penny 1s. 8d.

20 at 1s. $4\frac{1}{2}$d. = 20 at $1\frac{3}{8}$s. = £$1\frac{3}{8}$ = £1 7s. 6d.

One hundred, the price of one being given :—

Call the number of the farthings in the price pence, and double the number call shillings.

100 at $2\frac{3}{4}$d. = 11d. + 22s. = 22s. 11d.
100 at $9\frac{1}{4}$d. = 37d. + 74s. = 77s. 1d.

One thousand, the price of one being given :—

Call the number of farthings in the price pounds, and ten times the number call pence.

1,000 at $5\frac{1}{4}$d. = £21 + 210d. = £21 17s. 6d.
1,000 at 1s. $8\frac{1}{4}$d. = £81 + 810d. = £84 7s. 6d.

One Imperial ton, the price per lb. being given :—

RULE :—Price per lb. in farthings × 7 ÷ 3 (or ÷ 3 × 7).

$3\frac{1}{4}$d. per lb. = 13 × 7 = 91, and 91 ÷ 3 = $30\frac{1}{3}$ = £30 6s. 8d.
$11\frac{1}{4}$d. „ „ = 45 ÷ 3 = 15, and 15 × 7 = £105.

One lb. in nearest farthings, the price per Imperial ton being given ; the converse of the foregoing rule ; or, which is simpler :—

RULE :—Divide the price in £ by 9 = price per lb. in pence nearly exactly.

EXAMPLE :—£15 10s. 0d. ÷ 9 = $1\frac{3}{4}$ nearly. Answer $1\frac{3}{4}$d.

The last rule also applies to price of Imperial cwt. given in shillings :—18s. per cwt. = 18 ÷ 9 = 2d. per lb. nearly.

Other calculations may easily be made, by remembering simple facts, such as 240 pence make one pound.

Thus if 250 articles cost £1 15s. 0d., what is the cost of one, in nearest number of farthings?

£1 15s. 0d. being £1¾, therefore 1¾d. would be the cost if there were 240 articles, and this is the cost per article of 250 in nearest number of farthings.

MENTAL DATE CALCULATING.

For finding "*with rapidity*" the day of the week of any date in this century: very handy for making appointments without a Calendar.

Rule:—Add together the figure for the year, the month, and the day of the month, dropping all the sevens as they occur, and if 1 remains, it will be the first day of the week (Sunday) 2, Monday, &c., 0, the last day of the week (Saturday).

To find the figure for the year:—To the last two figures of the year, add as many leap years as there have been in the century, and divide by 7; the remainder is the figure for the year.*

EXAMPLE:—What is the figure for 1945?
Process: 45 + 11 = 56. 56 ÷ 7, remainder = 0.
Answer: 0.

To find the figure for the month:—Learn by heart the following numbers for each month, which *never alter*.

This will be found very easy by associating with a month the figure given, in any way that may occur to the reader. For instance, the figure for January is 1: January is the 1st month. The figures for February, March, and April are 4, 4, 0, and correspond with the number of yards in ¼ mile. Those for May, June, and July correspond to ¼ of 1,000 (2, 5, 0), and so on.

* Remembering in January and February of a leap year not to count that year as a leap year.

January	1*	May	2	September	6
February	4	June	5	October	1
March	4	July	0	November	4
April	0	August	3	December	6

EXAMPLE:—What day of the week is May 29, 1904? Answer: Sunday.

Process: Figure for year + figure for month + day of month.

$$5 + 2 + 29 = 36.$$
$$36 \div 7, \textit{remainder} = 1. \quad \text{Sunday.}$$

Therefore no business appointments must be made for this date.

When a date in the last century is required, add 2, except for the year 1900, which is 0.

The figure for 1901 = 1; 1902 = 2; 1903 = 3; 1904 = 5; 1905 = 6; 1906 = 7 or 0; 1907 = 1; 1908 = 3, and so on: *i.e.*, the numbers advance 1 every year except leap years, which advance 2. If the reader only wishes to learn the rule for finding any date in the year only, these can be remembered for each year as it comes along.

COMMISSION OR INTEREST.

A very useful rule to remember for finding the commission (or interest for one year) on any sum under £100†:—

Take the nearest number of pounds (thus £76 4s. 2d. count as £76, and £47 17s. 11d. count as £48) and proceed as follows:—

Multiply the number of pounds by twice the rate per cent., point off the unit; the remainder is shillings. Treat the unit as pence and fifths of pence.

EXAMPLES:—

(1) £76 at 3½ per cent.
$76 \times 7 = 532$.
Answer 53s. 2⅖d.

(2) £47 at 4½ per cent.
$47 \times 8\frac{1}{2} = 376 + 23\frac{1}{2} = 399\frac{1}{2}$.
39s. 9½d. + 9½ (⅕d.) = 39s. 11⅗d.

* If the figure for a month is forgotten, it may be found in the following manner:—Figure for January = 1; add 31 days in January = 32. 32 ÷ 7 leaves 4 over. Therefore the figure for February is 4.

† Under a decimal system of coinage no such rules are necessary, the interest being immediately given in Pounds, Florins, and Mils by multiplying Principal by Rate, and pointing off two places.

Table for Finding the Interest on £100. And hence on any amount * for any number of Days at any Rate.

Days.	2½ per cent.	3 per cent.	3½ per cent.	4 per cent.	4½ per cent.	5 per cent.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
1	0 1½	0 2	0 2½	0 2⅔	0 3	0 3½
2	0 3¼	0 4	0 4⅔	0 5	0 5⅔	0 6⅔
3	0 5	0 6	0 7	0 7⅔	0 8⅔	0 9⅔
4	0 6¾	0 8	0 9⅓	0 10⅔	0 11⅔	1 1⅔
5	0 8	0 9⅔	0 11⅔	1 1	1 2⅔	1 4⅔
6	0 9¾	0 11⅔	1 1⅔	1 3⅓	1 5⅔	1 7⅔
7	0 11½	1 1⅓	1 4	1 5⅔	1 8⅔	1 11
8	1 1	1 3⅓	1 6⅓	1 8	1 11⅔	2 2⅓
9	1 2¾	1 5⅓	1 8⅔	1 10⅔	2 2⅔	2 5⅔
10	1 4½	1 7⅓	1 11	2 1⅓	2 5⅔	2 8⅔
20	2 8¾	3 2⅔	3 10	4 2⅔	4 11	5 5⅔
25	3 5	4 1⅓	4 9⅓	5 3⅓	6 1⅔	6 10
30	4 1¼	4 11	5 9	6 4	7 4⅔	8 2⅔
31	4 2¾	5 1	5 11¼	6 5⅔	7 7⅔	8 5⅔
40	5 5⅝	6 3⅔	7 8	8 5⅓	9 10⅔	10 11⅔
50	6 10	8 2⅔	9 7	10 7⅓	12 3⅔	13 8⅓
60	8 2½	9 10⅔	11 6	13 1⅓	14 9⅓	16 5⅔
70	9 7	11 6	13 5	15 4	17 3	19 2
80	10 11½	13 1⅓	15 4	17 0⅔	19 0⅔	21 0
87†	11 11	14 3⅓	16 8	19 0⅔	21 5⅓	23 10
90‡	12 4	14 9⅓	17 3	19 8⅓	22 2⅔	24 7⅓
91§	12 5½	14 11⅔	17 5⅓	19 11⅔	22 5⅔	24 11
97‖	13 3⅓	15 11⅔	18 7	21 2⅔	23 11	26 6⅔
100	13 8⅓	16 5⅔	19 2	21 11	24 8	27 4⅔
120	16 5½	19 8⅔	23 0	26 3⅓	29 7	32 10⅔
140	19 2	23 0	26 10⅓	30 8	34 6⅓	38 4⅔
150	20 6⅓	24 7⅓	28 9	32 10⅔	36 11⅔	41 1⅔
160	21 11	26 3⅓	30 8	35 0⅔	39 5⅓	43 10
180	24 7⅓	29 7	34 6⅓	39 5⅓	44 4⅓	49 3⅓
200	27 4⅓	32 10⅔	38 4⅔	43 10	49 3⅓	54 9⅓
220	30 1⅓	36 2	42 2	48 2⅔	54 3	60 3⅓
240	32 10⅔	39 5⅓	46 0⅔	52 7⅓	59 2	65 9
250	34 3	41 1	47 11⅔	54 9⅓	61 7⅓	68 6
260	35 7⅓	42 8⅓	49 10⅔	56 11⅔	64 1⅔	71 3
280	38 4⅓	46 0⅔	53 8⅓	61 4⅓	69 0⅔	76 8⅓
300	41 1	49 3⅓	57 6⅔	65 9	73 11⅔	82 2⅔
320	43 10	52 7⅓	61 4⅔	70 1⅓	78 10⅔	87 8
340	46 7	55 10⅔	65 2⅔	74 6⅔	83 10	93 2
350	47 11½	57 6⅔	67 1⅔	76 8⅔	86 3⅓	95 10⅔
365	50 0	60 0	70 0	80 0	90 0	100 0

The Footnotes to this Table will be found at the foot of the next page.

Time at which Money Doubles Itself at Interest.

The number of years a sum of money takes to double itself at any rate of Compound Interest not exceeding 10 per cent. per annum, is approximately the number 70 divided by the Rate per cent.

Table for Finding the Number of Days from any Day in one Month to the same Day in any other Month (not inclusive).

FROM. \ TO.	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.
January	365	31	59	90	120	151	181	212	243	273	304	334
February	334	365	28	59	89	120	150	181	212	242	273	303
March	306	337	365	31	61	92	122	153	184	214	245	275
April	275	306	334	365	30	61	91	122	153	183	214	244
May	245	276	304	335	365	31	61	92	123	153	184	214
June	214	245	273	304	334	365	30	61	92	122	153	183
July	184	215	243	274	304	335	365	31	62	92	123	153
August	153	184	212	243	273	304	334	365	31	61	92	122
September	122	153	181	212	242	273	303	334	365	30	61	91
October	92	123	151	182	212	243	273	304	335	365	31	61
November	61	92	120	151	181	212	242	273	304	334	365	30
December	31	62	90	121	151	182	212	243	274	304	335	365

EXAMPLE :—Required the number of days between May 24 and December 25 By looking in the fifth line (May) of the last column (December), we find that there are 214 days between May 24 and December 24, and we know, therefore, that there are 215 days from May 24 to December 25.

☞ Should February 29 come between the dates referred to, add 1.

---

*, See mental rule for converting all sums under £1 into decimal parts of a pound, page 195. ‡ Christmas to Lady Day = 90 days ; in leap year 91 days.

§ Lady Day to Midsummer = 91 days = 13 weeks or ¼ year nearly.

‖ Midsummer to Michaelmas = 97 days. ‡ Michaelmas to Christmas = 87 days.

NOTE.—It is therefore more proportionate to begin Quarters on the first days of months and end them on last days of months, as in the Colonies.

Table for Converting any number of Days into Decimal Parts of a Year.

This Table will be found very useful for apportioning Interest or other amounts, for any number of days in a year, especially when the shillings and pence (if any) in the sum to be apportioned are also reduced to decimals (see Mental Rule, p. 195). The sums, if lengthy, may be worked by Logarithms, or Calculating Machines.

No. of Days.	Decimal Parts of a Year.	No. of Days.	Decimal Parts of a Year.
1	·00274	30	·08219*
2	·00548	40	·10959
3	·00822	50	·13699
4	·01096	60	·16438
5	·01371	70	·19178
6	·01644	80	·21918
7	·01918	90	·24658
8	·02192	100	·27397
9	·02466	200	·54794
10	·02740	300	·82192
20	·05479	365	1·00000

EXAMPLES :—

31 days :* 30 = ·08219
1 = ·00274
31 days = ·08493 of a year.

317 days : 300 = ·82192
10 = ·02740
7 = ·01918
317 days = ·86850 of a year.

£1,000 per annum for 317 days therefore equals £868 10s. 0d.

* An exact twelfth of a year is ·08333.

Income, Expenses or Wages Table.

Per Year.	Per Cal. Month.	Per Week.	Per Day. (*a*)	Per Year.	Per Cal. Month.	Per Week.	Per Day. (*a*)
£	£ s. d.	s. d.	d.	£	£ s. d.	£ s. d.	s. d.
1	0 1 8	0 4½	0⅔	16	1 6 8	0 6 1⅓	0 10⅔
2	0 3 4	0 9	1¼	17	1 8 4	0 6 6⅔	0 11⅓
3	0 5 0	1 1½	2	18	1 10 0	0 6 11	0 11¾
4	0 6 8	1 6	2⅔	19	1 11 8	0 7 3⅓	1 0⅓
5	0 8 4	1 11	3¼	20	1 13 4	0 7 8	1 1¼
6	0 10 0	2 3½	4	30	2 10 0	0 11 6½	1 7¾
7	0 11 8	2 8½	4⅔	40	3 6 8	0 15 4⅔	2 2¼
8	0 13 4	3 1	5⅓	50	4 3 4	0 19 2½	2 9
9	0 15 0	3 5½	6	52	4 6 8	1 0 0	2 10¼
10	0 16 8	3 10½	6⅔	60	5 0 0	1 3 1	3 3⅓
11	0 18 4	4 2½	7¼	70	5 16 8	1 6 11	3 10
12	1 0 0	4 7½	8	78	6 10 0	1 10 0	4 3⅓
13	1 1 8	5 0	8⅔	80	6 13 4	1 10 9½	4 4⅔
14	1 3 4	5 4½	9⅓	90	7 10 0	1 14 7½	4 11¼
15	1 5 0	5 9½	9¾	100	8 6 8	1 18 5½	5 5¾

a These figures are for 7 days to the week; if 6 working days only are required, add one-sixth to the figures in this column.

LOGARITHMIC TABLES.

As the use of Logarithmic Tables is comparatively known to but few, a definition and a few examples of Multiplication, Division, Proportion, &c., by their aid are here given, the same having been taken by kind permission from the Explanation at the commencement of Chambers's Mathematical Tables (W. and R. Chambers, Ltd., London and Edinburgh), to which book the reader is referred for a fuller explanation. It is evident that if we used a Decimal System of Weights, Measures, and Coinage, Logarithms would be of much more service to us (see example in Arithmetic, page 127).

DEFINITION:—"A Table of Logarithms is a collection of auxiliary numbers, so constructed, that by it Multiplication of common numbers can be performed by *addition* of their Logarithms; Division by their *subtraction;* Involution, or raising of powers, by their *multiplication;* and Evolution, or extraction of roots, by their *division*. These auxiliaries or Logarithms are the exponents or powers to which an invariable number called the *base* has to be

raised, in order to produce the number of which it is the Logarithm."

In Common Logarithms the base is 10.

The only mental fatigue in Logarithms is copying the numbers out of a book. They should be used in all Schools.

EXAMPLES :—

Multiplication by Logarithms :—2·581926 × 345·7291 = 892·647, as follows :—

Log.	2·581926	=	0·4119438
„	345·7291	=	2·5387359
Product = 892·647.	Its log.	=	2·9506797 Sum

Division by Logarithms :—371·49 ÷ 52·376 = 7·092752, as follows :—

Log.	371·49	=	2·5699471
„	52·376	=	1·7191323
Quotient = 7·092752.	Its log.	=	0·8508148 Difference

Involution by Logarithms :—$(30{\cdot}7146)^3$ = 28975·75, as follows :—

Log.	30·7146	=	1·4873449
			×3
Power = 28975·75.	Its log.	=	4·4620347

Evolution by Logarithms :—The cube root of 12,345 = 23·11162, as follows :—

Log. 12,345 = 4·0914911	
Divide by 3 = 1·3638304	Log. = 23·11162

Proportion by Logarithms :—

$$723{\cdot}4 : {\cdot}02519 :: 3574{\cdot}862 : x.$$
$x = {\cdot}1244827$ as follows :—

Add together the logs. of the second and third terms, and from their sum subtract the log. of the first, and the remainder will be the log. of the fourth term.

Log.	·02519	$= \bar{2}{\cdot}4012282$
,,	3574·862	$= 3{\cdot}5532592$
		$1{\cdot}9544874$
,,	723·4	$= 2{\cdot}8593785$
$x =$	·1244827. Its log.	$= \bar{1}{\cdot}0951089$

MENSURATION.

Practical Mensuration with the "rational Metric Measures and Weights" and their decimal gradations, is stupendously easier than by the "antiquated system under which we suffer" (the words in parentheses are those of the Right Hon. A. J. Balfour, Prime Minister).

(For Mathematical Signs, see page 230.)

Definitions :—The term parallelogram includes a square, rectangle, rhombus and rhomboid (opposite sides equal and parallel) : a trapezoid has only two of its sides parallel ; other quadrilateral figures are called trapeziums.

A frustrum of a solid is a slice of it contained between the base and any plane parallel to the base ; the base and the opposite face are called the "ends" of the frustrum.

Rules :—

IN RIGHT-ANGLED TRIANGLES, the hypothenuse $= \sqrt{\text{base}^2 + \text{perpendicular}^2}$; the third side $= \sqrt{\text{hypothenuse}^2 - \text{given side}^2}$ *or* $\sqrt{(\text{hypothenuse} + \text{given side})(\text{hypothenuse} - \text{given side})}$.

AREA OF A TRIANGLE = base × ½ perpendicular height.

,, ,, ,, the three sides being given ; let AB, BC, CA, represent the three sides, and S = ½ their sum ; then the area $= \sqrt{S(S-AB)(S-BC)(S-CA)}$.

AREA OF AN EQUILATERAL TRIANGLE = one side × ·433.

AREA OF A PARALLELOGRAM = base × height.

AREA OF A RHOMBUS OR SQUARE is also = ½ product of the two diagonals.

AREA OF A TRAPEZOID = ½ sum of 2 parallel sides × perpendicular distance between them.

AREA OF A TRAPEZIUM = longest diagonal × ½ sum of the 2 perpendiculars falling upon it from the opposite angles (or by next rule).

FOR AREA of any figure of 4 or more unequal straight sides, divide it into triangles and find the area of each separately.

A HEXAGON is a figure of 6 equal sides, each side being equal to the radius of the circle described around it.

FOR AREA OF ANY REGULAR SIDED FIGURE; ½ radius of inscribed circle × length of one side × no. of sides.

THE CIRCUMFERENCE OF A CIRCLE = diam. × $\frac{355}{113}$ *or* 3·1416 *or* $3\frac{1}{7}$.

Note:—$\frac{355}{113}$ is easy to remember, for it is made up of the first three odd numbers used twice each, and is correct to 6 decimal places: it is convenient for finding 3·1416 should one forget that number.

Also note:—·7854, ·5236 used hereafter are respectively $\frac{1}{4}$ and $\frac{1}{6}$ of 3·1416; and so on.

DIAMETER OF A CIRCLE = circumference × ·31831.

AREA OF A CIRCLE = area of a triangle having a base equal to the circumference and a height equal to the radius.

AREA OF A CIRCLE = ½ radius × circumference,
or radius² × 3·1416
or diameter² × ·7854
or circumference² ÷ (3·1416 × 4)
or circumference² × ·07958

CIRCUMFERENCE OF AN ELLIPSE = ½ sum of long and short diameters × 3·1416.

AREA OF AN ELLIPSE = long diameter × short diameter × ·7854.

LENGTH OF ARC OF A CIRCLE = 360 : no. of degrees in angle subtending the arc :: circumference of circle : length of arc
or no. of degrees × radius × ·017453
or from 8 times the chord of half the arc, subtract the chord of the whole arc and divide the remainder by 3.

AREA OF SECTOR OF A CIRCLE = arc × ½ radius
or 360° : no. of degrees in angle subtending the arc :: area of circle : area of sector.

AREA OF SEGMENT OF A CIRCLE = area of sector which has the same arc — area of triangle formed by the radii and the chord.

SURFACE OF A SPHERE = diameter² × 3·1416
or diameter × circumference.

CONTENTS OF A SPHERE = diameter³ × ·5236
or area of surface × ⅙ radius.

SURFACE OF A CYLINDER OR PRISM = areas of two ends, added to the perimeter of one end multiplied by the length.

CONTENTS OF A CYLINDER OR PRISM = area of one end × length.

CONTENTS OF PRISMOIDS = To the sum of the area of the two ends, add 4 times the middle area and × the sum by ⅙ of height.

LENGTH OF A RING = Sum of radii of the outer and inner boundaries × 3·1416.
or ½ sum of outer and inner boundaries
or outer boundary − circumference of cross section.
or inner " + " "

SURFACE OF A PLANE RING, *i.e.*, the space between 2 concentric circles = sum of radii × their difference × 3·1416.

SURFACE OF A SOLID RING = circumference of circular section of the ring × length of the ring.

CONTENTS OF A RING = area of cross section × length.

CONTENTS OF A SPHERICAL SHELL = outer diameter^3 − inner diameter^3 × ·5236.

CONTENTS OF A ZONE OR SEGMENT = To 3 times radius of base^2 + square of height and × ·5236 of height.

SURFACE OF A CONE OR PYRAMID = ½ (slant height × perimeter of base) + area of base.

SURFACE OF A FRUSTRUM = ½ (slant height × perimeter of two ends added together) + areas of both ends.

CONTENTS OF A CONE OR PYRAMID = ⅓ perpendicular height × area of base.

CONTENTS OF A FRUSTRUM = To area of the two ends + the square root of their product and × ⅓ of height.

AREA OF A PARABOLA = base × ⅔ height.

SIMILAR TRIANGLES, PARALLELOGRAMS AND CIRCLES.

The areas of similar figures are as the squares of corresponding lengths.

EXAMPLES: Letting 1 equal the whole figure.

TO DIVIDE A TRIANGLE into say 3 equal parts, by lines parallel to the base.

1 : ⅓ : : height of whole figure^2 : height of smallest triangle^2.

And so on.

TO DIVIDE A PARALLELOGRAM into 5 equal concentric figures :—

1 : ⅕ : : length of diagonal of whole figure^2 : length of diagonal of innermost figure^2.

And so on.

TO DIVIDE A CIRCLE say into 4 equal parts by circles :—

1 : ¼ : : radius of whole figure^2 : radius of circle enclosing ¼ area^2.

And so on.

The contents of similar solids are as the cubes of corresponding lengths.

EXAMPLES :—(1) Diameter of 2 spheres are 5 and 4 ; then :—the volume of 1st sphere : volume of 2nd sphere : : $5^3 : 4^3$, *i.e.*, as 125 is to 64. (So that the larger sphere is almost double of the other.)

(2) From a pyramid 12 meters in height, cut off a frustrum equal to one-fourth of the pyramid. The remaining pyramid will be three-fourths of the original pyramid, and the two pyramids will be similar. Therefore the cube root of three-fourths of $12^3 = 3\sqrt{\frac{3}{4}}$ of $12^3 = 3\sqrt{\frac{3}{4}}$ of $1728 = 3\sqrt{1296} = 10{\cdot}9$ meters = height of smaller pyramid ; and height of frustrum = 12 − 10·9 = 1·1 meter.

Round or Unhewn Timber.—For Rule, see page 52.

MEASUREMENTS FOR SMALL SQUARE AND CIRCULAR ENCLOSURES:—

Area.	Side of Square, Imp. ft.	Four Sides. Imp. ft.	Radius circle. Imp. ft.	Circumference. Imp. ft.
1 Quebec arpent	192	767½	108	680
2 " "	271¼	1085	153	961
1 Imp. Acre	208¾	835	117⅝	740
2 " "	295¼	1181	166½	1046
1 Morgen	303½	1214	171⅛	1076
2 "	429½	1718	242¼	1522

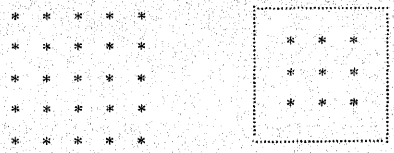
In the second column we see the disadvantage of the Quebec Imperial and Cape systems as compared with the Metric System. For without calculation the Metrician knows that the side of a square, one hektar in extent, is 100 meters. And his barbed wire is made 10 meters to the kilogram (see footnote on page 211), and in foreign countries his prices are decimal in progression. A foreigner can therefore calculate the cost of enclosing a square-shaped hektar of land, in his head, before the Britisher has had time to think of it.

FOR PLANTING TREES, &c.

To find the number of Vines, Trees, or other Plants, required to plant a square area, divide the number of feet in one side of the square by the number of feet the rows are to be from one another, and if there are to be rows on the boundaries of the figure *add* 1, but if the rows are to be fenced in and to be as far from the fences as from one another, *deduct* 1, and square the result.

The reasons for adding or deducting 1, are easily seen in the diagrams of areas say 4 meters square, which appear on the next page, where the plants are to be 1 meter apart.

If the cross rows are to be different distances apart, divide each side by the number of feet the respective rows are to be apart (deducting or adding 1 as before) and multiply the two results together.



The result would be only approximately right if the figure of the area were other than square.

BARBED WIRE.

From the table on the previous page, it will be seen how, if economy or time is to be considered, that by having circular instead of square enclosures, a great saving is made in the length of fencing required to enclose a given area.

Number of lbs. (with barbs 6 in. apart), required for the following distances, with 1, 2, or 3 strains, not allowing for twists round posts :—

Distances.	Imp. feet.	lbs. for 1 strain.	lbs. for 2 strains.	lbs. for 3 strains
100 Imp. feet	100	$6\frac{2}{3}$	$13\frac{1}{3}$	20
100 Cape feet	$103\frac{1}{3}$	7	14	$20\frac{2}{3}$
180 Quebec feet = 1 arpent	192	13	$25\frac{2}{3}$	$38\frac{1}{3}$
100 Imp. yards	300	20	40	60
1000 Imp. feet	1000	$66\frac{2}{3}$	$133\frac{1}{3}$	200
1000 Cape feet	1033	69	$137\frac{2}{3}$	$206\frac{2}{3}$
100 Cape roods	$1239\frac{1}{2}$	$82\frac{2}{3}$	$165\frac{1}{3}$	248
100 Imp. poles or 25 Imp. chains	1650	110	220	330
80 Imp. chains or 1 Imp. st. mile	5280	352	704	1056

A roll of barbed wire, with barbs 6 in. apart, weighs 100 lbs., and measures 1,500 Imperial feet*; so to find the number of lbs. of barbed wire required to fence a distance, divide the number of feet run by 15. If the barbs are required 3 in. apart, 100 lbs. only measure 1,350 feet, and the number of feet run must be divided by 13·5 (or multiplied by 2 and divided by 27), or the results in the foregoing table may be multiplied by 10 and divided by 9.

TABLE OF SPEEDS AND VELOCITIES

From 1 meter in a fortnight to 463,000 kilometers per second.

Units of Velocity :—1 meter per second, and 1 kilometer per hour.

Note :—To convert meters to yards, add 10 per cent.

" " kilometers to miles, $\times \frac{6}{10}$.

" " meters to feet, $\times$ 10 and $\div$ 3.

Eucalyptus trees sometimes grow at the rate of 1 meter in a fortnight ; and Bamboos 1 meter in less than 2 days.

Camels can travel for 8 days, at the rate of 160 kilometers per day.

A man walking 6½ kilometers an hour travels over 1¾ meters per second.

Gentle Breezes travel about 2 meters per second.

A Union Castle Boat mid-ocean travels about 7½ to 9 meters per second.

Storm Clouds travel 50 to 65 kilometers per hour, equal to about 13½ to 18 meters per second.

Horses running and Hawks flying can travel 15 meters per second.

* Therefore 10 yards weigh 2 lbs., and 11 yards (= 10 Meters) weigh 2·2 lbs. or 1 Kilogram. That is to say, 10 meters of barbed wire, with barbs 15 centimeters (6 inches) apart, weigh exactly 1 kilogram. Compare "count lengths" of *Yarns*, page 71.

Carrier Pigeons can travel 18 meters per second.

Trains at 100 kilometers per hour travel nearly 28 meters per second.

Sensations in human nerves travel about 30 meters per second.

Wind travels in a great storm about 30 meters per second, and in a tornado 46 meters.*

Falling bodies, on this Earth, travel in the—

1st second, 4·9 meters
2nd „ 14·7 „
3rd „ 24·5 „
4th „ 34·3 „ and so on, progressing in odd numbered multiples of 4·9. During the 8th second, after falling 300 ms., they attain a speed of over 75 ms. per second.

Sound travels, per second, through Air, 350 meters.
through Rock, 300 to 500 meters.
„ Water, 1,500 meters.
„ Wood, 3,300 to 5,200 meters.
„ Iron, 5,300 meters.

Muzzle velocity of a bullet from a Lee-Metford Rifle is about 600 meters per second.

Earthquake movement is propagated round the world at $3\frac{1}{3}$ kilometers per second, and through the Earth's solid mass a little quicker.

The Earth falls through space 30,400 meters or over 30 kilometers per second.

Light travels 309,000 kilometers per second.

Electricity travels 463,000 kilometers or $11\frac{1}{2}$ times round the Earth in a second.

The Mind is the swiftest thing, for it surveys all things in a moment (*Thales*).†

* The Jamaica hurricane, August, 1903, travelled about 190 kilometers per hour, equal to 53 meters per second.

† If Thales had been living to-day, he would, no doubt, have said that the minds of the decimal using people could calculate and comprehend statistics ten times as quickly as the minds of a people using an incomprehensible lot of weights measures, &c.

COLOURS.

Primaries: Red
Yellow
Blue

Secondaries, or *mixtures of two primaries* :—
Orange (red and yellow)
Purple („ „ blue)
Green (yellow and blue)

Tertiaries, or *mixtures of two secondaries* :—
Brown (orange and purple)
Grey („ „ green)
Brownish-Green (purple „ „)

The contrasts of Red are Green and Brown.
„ Yellow „ Purple „ Grey.
„ Blue „ Orange „ Brownish-Green.

In mixing paints :—

Brown	= Red and Black
Buff	= Light Red, Yellow and White
Cream	= „ „ „
Chocolate	= „ and Black
Drab	= „ Umber and White
Flesh colour	= Lake, Vermilion and White
Pearl Grey	= White, Black and a little Blue
Pink	= Carmine and White
Purple	= Blue and Lake
Olive	= Blue, Red and a little Black

THE MORSE CODE.

Most signalling codes are based on this alphabet or "dot-dash" system :—

A · —	H · · · ·	O — — —	V · · · —
B — · · ·	I · ·	P · — — ·	W · — —
C — · — ·	J · — — —	Q — — · —	X — · · —
D — · ·	K — · —	R · — ·	Y — · — —
E ·	L · — · ·	S · · ·	Z — — · ·
F · · — ·	M — —	T —	
G — — ·	N — ·	U · · —	

RACES OF MANKIND.

White and Light Brown:—Europeans, Jews, Circassians, Egyptians, Arabs.

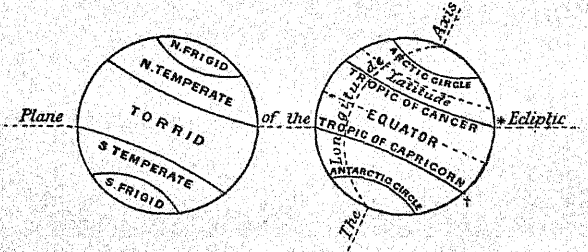
Brown:—Abyssinians, Hindoos, Malays, Maoris, and most Pacific Islanders.

Yellow:—East, South-East, Central and Northern Asiatics, Laplanders and Eskimos (will rapidly spread wherever a footing is allowed).

Red:—North and South American aboriginals.

Black:—African, Australian, and New Guinea aboriginals, and a few Pacific Islanders.

THE ZONES AND IMAGINARY LINES OF EQUATOR, LATITUDE AND LONGITUDE.



THE ZONES AND IMAGINARY LINES.

The **Equator** is midway between the two *Poles*.

The inclination of the Equator to the *Ecliptic* is 23° 27½′, and necessarily of the Earth's axis, 66° 32½′.

Tropics of **Cancer** and **Capricorn** ‡ are 23° 27½′ from the Equator, and are respectively the Northern and Southern Tropics.

* Summer Solstice (Northern Hemisphere).
† Winter Solstice (Northern Hemisphere).
‡ These names are derived from the fact that the Sun reaches its highest altitude (the solstices) when in these signs of the Zodiac. See page 219.

Arctic and **Antarctic Circles** are 66° 32½′ from the Equator.

These last four parallels divide the Earth into the Northern and Southern **Frigid** and **Temperate Zones** and the **Tropical** or **Torrid Zone.**

Lines of **Latitude** vary in length, being drawn parallel to and both North and South of the Equator; those within one degree of the Equator being known as 1° North or South Latitude, and so on to the Poles which are 90°, the Equator being 0. They are also called Northern and Southern **Parallels.**

Lines of **Longitude** are all the same length, being drawn from pole to pole, cutting the Equator at right angles; those within one degree of the Meridian of Greenwich being known as 1° East or West Longitude of Greenwich, and so on to 180°, most countries now reckoning Greenwich as 0, and using Greenwich time (see page 173).

Thus the Polar regions together cover but 46° 55′ of the Earth's surface where the lines of latitude are *shortest*; the Tropical 46° 55′ where they are *longest*; and the Temperate Regions no less than 86° 10′ of that part of the Globe in which there is most of the Land Surface.

THE EARTH.

NOTE.—To convert kilometers to miles multiply by $\frac{6}{10}$, or if greater accuracy is required by $\frac{5}{8}$.

The Earth is 147¼ millions of kilometers from the Sun, when nearest to it at Perihelion on January 1 (perigee), at which time it moves quickest through space; and furthest from it, viz., 152 millions of kilometers, when in Aphelion on July 2 (apogee), when it moves slowest. Its mean distance from the Sun is about 150 millions of kilometers, and the eccentricity of its orbit is ·017.

The Earth's Polar and Equatorial diameters are 12,713 kilometers and 12,756 kilometers respectively, a difference of 43 kilometers and a proportion of 292 to 293*; being an oblate or elliptic Spheroid, its mean diameter is 12,742 kilometers.

The Polar or longitudinal circumference is 40,008 kilometers, and the Equatorial or latitudinal circumference is 40,076 kilometers.

* Weights and the lengths of a seconds pendulum vary accordingly at different parts of the Earth's surface.

The quadrant of the arc of the Meridian is therefore 1,002 kilometers, instead of 10,000 kilometers, as was supposed when the original meter was constructed.

THE MOON AND THE TIDES.

The Moon's mean distance is 384,375 kilometers, and the eccentricity of its orbit is ·05.

The Moon causes the Tides, by attracting the Water (a loose body) more towards it than the solid part of the Earth; it also acts on the solid part of the Earth as a whole, pulling it away from the water on the other side: the Water is therefore heaped up on *each* side of the Earth, by the Moon's action, causing two tides a day instead of one.

The Sun also does the same in a lesser degree.

At New Moon, the Sun and Moon pull together, and very high tides are formed.

At Full Moon, the high tides are nearly as high as at New Moon, the Sun and Moon acting together in pulling a higher tidal wave than the average, on each side of the Earth.

The extra high tides are called "Spring Tides," and the extra low tides "Neap Tides"; the greatest elevations and depressions are not observed until the second or third day after the Full or New Moon.

The intensity of tides diminishes from the equator towards the poles.

At the same time every evening the Moon is about 12° higher, or further from the point in the heavens where the Sun sets, (360° in about 30 days), *i.e.*, about 48 minutes (time) later, which time represents the delay in high tide every succeeding day, and consequently 24 minutes in the delay of each succeeding tide.

Phases of the Moon.

● New Moon	○ Full Moon
☽ First Quarter*	☾ Last Quarter*

* The phases are thus shown in almanacs, but it should be noted that South of the Equator the crescents of the Moon in the First and Last Quarters appear the reverse way round to what they do North of the Equator. That is to say, the appearance of a waxing Moon in the Northern Hemisphere is that of a waning Moon in the Southern.

THE PLANETS.

Name of Planet, or "Wandering" Star.	Symbol.	Moons.	Mean distance from Sun in millions of kilometers.	Mean distance from Sun taking the Earth's as 1.	Approximate time of revolution round Sun in years.	Mean diameter in kilometers.	Density compared with water.
Mercury	☿	...	58	0·38	$\frac{1}{4}$	4,815	6·85
Venus	♀	...	108	0·72	$\frac{2}{3}$	12,327	4·81
The Earth	⊕	1	150	1·00	1	12,735	5·66
Mars	♂	2	227	1·52	$1\frac{7}{8}$	6,760	4·01
Planetoids (av.)..	...	...	428	2·86	...	...	...
Jupiter	♃	5	776	5·20	$11\frac{7}{8}$	140,500	1·38
Saturn	♄	8*	1,423	9·54	$29\frac{1}{2}$	114,300	0·75
Uranus	♅	4	2,865	19·18	84	51,000	1·28
Neptune	♆	1	4,475	30·05	165	55,500	1·15

Symbol for Sun ⊙ : diameter 1,395,000 kilometers.

For converting kilometers to miles in above, multiply by $\frac{6}{10}$, or if greater accuracy is required $\frac{6}{9}$ or ·62137.

The Planets or "wandering stars" all move round the Sun in the same direction, and under certain laws discovered by Kepler :—

(1) Every planet moves in an ellipse, with the Sun at one of the foci.
(2) The straight line drawn from the centre of the Sun to the centre of the planet sweeps out equal areas in equal times.
(3) The squares of the periodic times of the several planets are proportional to the cubes of their mean distances from the Sun.

The distances of the Planets from the Sun can be better appreciated by a knowledge of *Bode's Law*, which is approximately true, except in the case of Neptune, the furthest planet, in which case the result is far too great. It is as follows :—

* And 3 rings.

To the series of numbers, 0, 3, 6, 12, 24, 48, 96, 192, 384, each one of which (after the second) is double the preceding one, add 4 to every term, and obtain

4, 7, 10, 16, 28, 52, 100, 196, 388,

representing the relative distances, 10 being that of the Earth.

There is also a small Planet, named Vulcan, within a distance of 20 million of kilometers of the Sun.

The Planets whose distances from the Sun are less than that of the Earth, are termed the *inferior* planets, and those whose distances are greater, the *superior* planets.

THE STARS.

The "fixed ' stars are distinguished from the Planets by remaining, as far as our sight reveals to us, immovable with respect to one another. The apparent motions noticeable to the casual observer arise through the Earth rotating on its axis, causing the stars to either rise in the east, and set in the west (like the Sun), or describe a complete circle, the centre of which is in line with the Earth's axis. The stars in the same plane as the Earth's Equator, are the "zodiacal" stars, visible in both the Northern and Southern hemispheres. The same position of the stars in respect to the Earth recurs nearly four minutes earlier each night, and only at the same time after the lapse of a year (see "Sidereal day," page 172). At the Equator therefore, during a year, the whole Northern and Southern starry firmament comes into view. Stars are arranged in magnitudes, according to their brilliancy, stars up to the sixth magnitude being visible to the naked eye. We cannot say whether greater brilliancy of a star arises from its comparative proximity, size, or greater intensity of light. The nearest fixed star is distant over 200,000 times the Earth's orbit.

A FEW ASTRONOMICAL SYMBOLS.

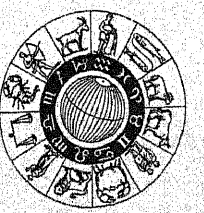
	°		°
☌ Conjunction.	0	☍ Opposition.	180
⚹ Sextile.	60	☊ Ascending Node.	
□ Quadrature.	90	☋ Descending Node.	
△ Trine.	120	δ Declination.	

THE SIGNS OF THE ZODIAC.

The Sun, in its annual course, is always between the Earth and one of the constellations in the heavens, on the zodiacal line, which line has been divided into 12 parts,* so that each part contains a constellation or sign of 30°. The Sun takes one Solar or Calendar month to pass through one sign of the Zodiac. In 1904 †:—

Mar. 21st, at 1 *m.* he enters ♈ Aries (Spring begins ‡). *Vernal Eq.*
June 21st, „ 9 *a.* „ ♋ Cancer (Longest day; Summer begins). *Summer Solstice.*
Sept. 23rd, „ 0 *a.* „ ♎ Libra (Autumn begins). *Autumnal Equinox.*
Dec. 22nd, „ 6 *m.* „ ♑ Capricornus (Shortest day; Winter begins). *Winter Solstice.*

Signs of the Zodiac.



		° Long.			° Long.
♈ Aries	... The Ram	0	♎ Libra	... The Balance	180
♉ Taurus	... „ Bull	30	♏ Scorpio	„ Scorpion	210
♊ Gemini	... „ Twins	60	♐ Sagittarius	„ Archer	240
♋ Cancer	... „ Crab	90	♑ Capricornus	„ Goat	270
♌ Leo	... „ Lion	120	♒ Aquarius	„ Water-Bearer	300
♍ Virgo	... „ Virgin	150	♓ Pisces	... „ Fishes	330

* It was so divided as far back as B.C. 3000, and the names of the Signs of the Zodiac can be traced back to Babylonian ideas by the ancient mural paintings.

† The hours alter from year to year, but are corrected in leap years, which are omitted at the end of every century. A larger difference than usual, therefore, occurred in 1903, so that the shortest day actually fell on December 23rd.

‡ In the Northern Hemisphere; Spring and Autumn are not usually spoken of in the Southern Hemisphere; Summer and Winter, and the length of days are there reversed. Astronomical day begins at noon; hence instead of a.m. and p.m., we refer to morning (*m*) and afternoon (*a*).

These can be committed to memory as follows :—

The Ram, the Bull, the heavenly Twins,
And next the Crab, the Lion shines,
The Virgin and the Scales,
The Scorpion, Archer and She-goat,
The Man that holds the Watering-pot,
And Fish with glittering tails.

A FEW COMPARISONS BETWEEN THE BRITISH EMPIRE AND THE REST OF THE WORLD.

I. Area.

The surface of the Globe is about 510 million sq. Kilometers (197 million sq. miles).

Of this, nearly three-fourths is water, namely 375 million sq. Kilometers (145 million sq. miles).

This leaves a little more than one-fourth for the land, namely 135 million sq. Kilometers (52 million sq. miles).

Only about two-thirds of the land area, or approximately 90 million sq. Kilometers (35 million sq. miles) is inhabitable.

The families of the British Empire own about 21 per cent., or over one-fifth of the total land area, namely, about 30 million sq. Kilometers (11½ million sq. miles), and a very large proportion of this is inhabited.

II. Population.

Out of a total population on the globe, roughly commuted at 1,500 millions, upwards of 400 millions are British subjects, or about 26 per cent. (over one-fourth).

NOTE :—The British totals in I. and II. do not include Egypt,* where British influence is predominant, respected and valued, nor

	Sq. Kilometers.	Sq. Miles.	
Egypt Proper : Approx. Area	1,000,000	386,000	Pop. 9,734,000
Soudan Provinces „ „	2,500,000	965,000	„ 10,000,000
Totals :—Area	3,500,000	1,351,000	Pop. 19,734,000

* The Metric System is more used in Egypt than the Imperial.

the Protectorates over various Chieftainships from Aden to the head of the Persian Gulf.

III. Distribution.

The Polar regions together cover but 46° 55′ of the Earth's surface, where the lines of latitude are *shortest;* the Tropical, 46° 55′, where they are *longest;* and the Temperate regions, no less than 86° 10′ of that portion of the Globe in which there is most of the Land surface.

The Land and Water is distributed into Continents and Oceans approximately as follows :—

Land.	Millions of		Water.	Millions of	
	Square Kilometers.	Square Miles.		Square Kilometers.	Square Miles.
Australia	8	3	Polar Seas	31	12
Europe	11	4	Ind. Ocean	62	24
Africa	31	12	Atlan. „	93	36
N. and S. America	42	16	Pacific	186	72
Asia	43	16			
Totals	135	51	Totals	372	144

The United Kingdom comprises two islands in the centre of the Land area. Of the habitable land in the New World, the Empire owns the Northernmost; and of the habitable land in the Old World, it occupies nearly all the Southernmost land. Its territories now almost form a *horseshoe* round the Indian Ocean, for the Indian branch is stretching, as by a natural growth, towards Australia on the one hand and Egypt on the other, whilst between Egypt and the Cape the ties are continually strengthening.*

* See specially prepared Maps.
The Cape to Cairo Railway alone will bring about more changes than we can yet conceive. It will be about 8,000 Kilometers (5,000 miles) long, about one-half

It is doubtful, too, if we, the Empire's protectors for the time being, have the right to try and stop this natural growth. Rather should we turn our attention to the cutting away of everything that helps to stunt its growth and tends to its decay.

IV. Commerce.

The Arithmetical Language of Commerce, or Weights, Measures, and Coinage.—Whilst encouraging Trade within the Empire, therefore, we should at the same time foster its growth beyond its confines, by using the International Weights and Measures.

Although British subjects number one-fourth of the population of the Globe, only one-tenth of the World's peoples—or not one-half of the British subjects—use the British Weights and Measures. Whereas during the last half century the International Metric System, of modern design, has been adopted by one-third of the Earth's inhabitants, both in their home-trade and for their inter-commerce; and the Government representing one-fifth of the World's inhabitants (India) has twice been thwarted by the Imperial Parliament in its attempt to adopt the system.

Apart from hostile Tariffs, our trade also suffers from the vexatious way in which we treat our Customers, for our 500 millions of competitors for the World's Markets also buy from us.

Sir Edgar Vincent, K.C.M.G., M.P., summed up the position in a letter to the Decimal Association, dated March 15, 1902, as follows:—

"To sell to a man you must convince him."

"To convince a man you must talk his language."

"The language of our richest potential customers in relation to calculation is the Decimal System."

Some short-sighted people, however, say, "But if our incomprehensible system handicaps our trade in Foreign Countries, then surely it also hinders them from sending goods to the British Isles, India, and the Colonies." But although Foreigners, as retail

of which is already completed (2,150 Kilometers up to Bulawayo, and about 2,000 Kilometers down to Khartoum). It will bring into close touch, such as no other British Railway has yet done, Egypt, with its modern decimal coinage, weights and measures; East Africa, with its Indian coinage, &c.; and South Africa, with its Imperial weights and measures, and Dutch land measure. Which will come first—the Cape to Cairo Railway, or a uniform Imperial decimal system?

purchasers, will not study our system, as wholesale manufacturers they take copies of our standards for the very purpose of invading what were once considered our preserves. As a Continental writer recently put it, "Let the Britishers capture the Territory, as long as we capture the Trade."

When we turn to Coinage, we find that 11 European Countries have already adopted as a medium of International exchange facsimiles of the French franc and its derivatives, with the result that the commerce of each is fastly developing into an International one, and many other Countries now have monetary units based on the franc. Are we to allow the process to continue, or adjust our Coinage before it is too late?

Shipping.—About 8,000, or one-half of the World's Ocean-going steamships, and about 3,000 sailing vessels, carry the British Ensign. These steamships and sailing vessels respectively aggregate tonnages of over 12 and 2 millions, or a total of about 14 millions, the World's total (for vessels of 100 tons and upwards) being approximately 30 millions. (NOTE.—Throughout the World a register ton is reckoned as 2·83 cubic meters, but there is no International agreement regarding gross and net tonnage. See pages 53 to 59.)

V. Wealth.

Sir Robert Giffen, in a paper read before the British Association, September 11, 1903, assumed that the aggregate income of the people of the United Kingdom was about 1,750 millions, and their wealth about 15,000 millions. The wealth of the whole Empire, he considered, was about half as much again. Germany and France had probably only one-half and one-third this wealth respectively, whilst the economic force of the British Empire and United States combined, he estimated, would outweigh the whole of the rest of the World.

It is this vast wealth, accumulated by our forefathers, that is to-day helping us. Not our behind-the-times Home and International business methods.

VI. Language.

About 120 millions, or nearly one-tenth of the population of the World, can speak the English tongue, but only a few understand our Commercial Language.

THE ANGLO-AFRICAN EMPIRE.

With the times adopted under the system of "standard time," see p. 173.

Dominions, Protectorates, &c.	Government.	Area in sq. m.*	Population.
South Africa (2 hrs. fast on Greenwich).	(*High Commissioner*)		
Cape Colony with Walfish Bay	Self-governing Colony	277,151	2,000,000
Bechuanaland Pte.	Resident Commissioner	386,200	80,000
Rhodesia, including 450,000 sq. m. B. Central Africa	British S. Africa Coy. and Resident Commr.	750,000	600,000
Natal with Zululand	Self-governing Colony	34,019	937,000
Transvaal with Swaziland ...	Crown Colony	119,200	1,000,000
Orange River Colony... ...	,, ,,	48,326	208,000
Basutoland	Resident Commissioner	10,293	250,000
	Totals ...	1,625,189	5,075 000†
East and Central Africa (2 hrs. fast on Greenwich).			
British Central Africa Pte. ...	Foreign Office	50,000‡	845,000
Zanzibar and Pemba Pte. ...	,, ,,	985§	250,000
British East Africa Pte. (to 10° N.) (3 hrs. fast on Greenwich).	,, ,,	670,000	2,500,000
British Somaliland Pte. ...	,, ,,	90,000	150,000
Socotra and Perim	India ,,	1,382	12,000
	Totals ...	812,367	3.757,000
West Africa (actual Greenwich time).			
South Nigerian Pte.	Colonial Office	60,000	30,000,000
North Nigerian Pte.	Foreign Office	320,000	
Lagos and Protectorate ...	Crown Colony	26,700	2,000,000
Gold Coast ... ... (1 hr. slow on Greenwich).	,, ,,	40,060	1,500,000‖
Sierra Leone and Pte. ...	,, ,,	34,000	1,000,000
Gambia and Protectorate ...	,, ,,	3,550	90,000
	Totals ...	484,310	34,590,000
The following Islands (actual Greenwich time).			
St. Helena	Crown Colony	47	3,550
Ascension ... ... (4 hours fast on Greenwich).	Admiralty Office	38	450
Mauritius, Rodrigues and Chagos	Crown Colony	800	400,000
Seychelles	Crown Colony.	149	20,000
	Totals ...	1,034	424,000
	Grand Totals ...	2,922,900	43,846,000

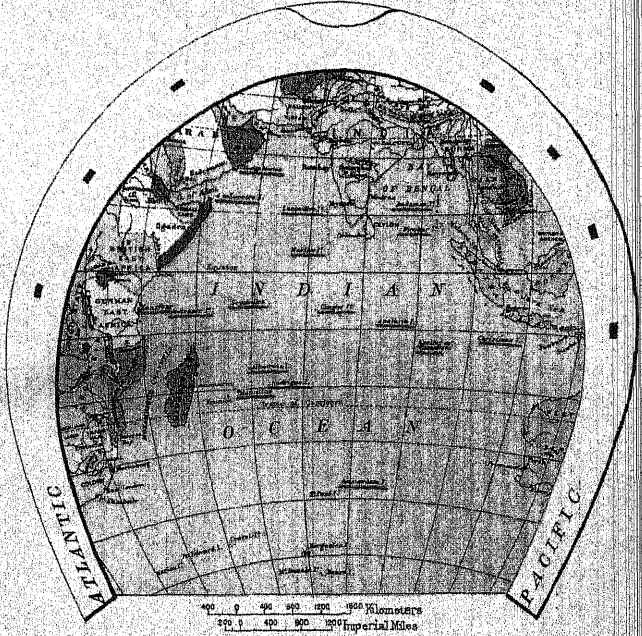
* For converting into sq. kilometers × 2·6. † Whites, less than 1 million.
‡ See also Rhodesia. § Excluding strips coastland now B.E. Africa.
‖ Excluding Ashantis.

BRITISH POSSESSIONS

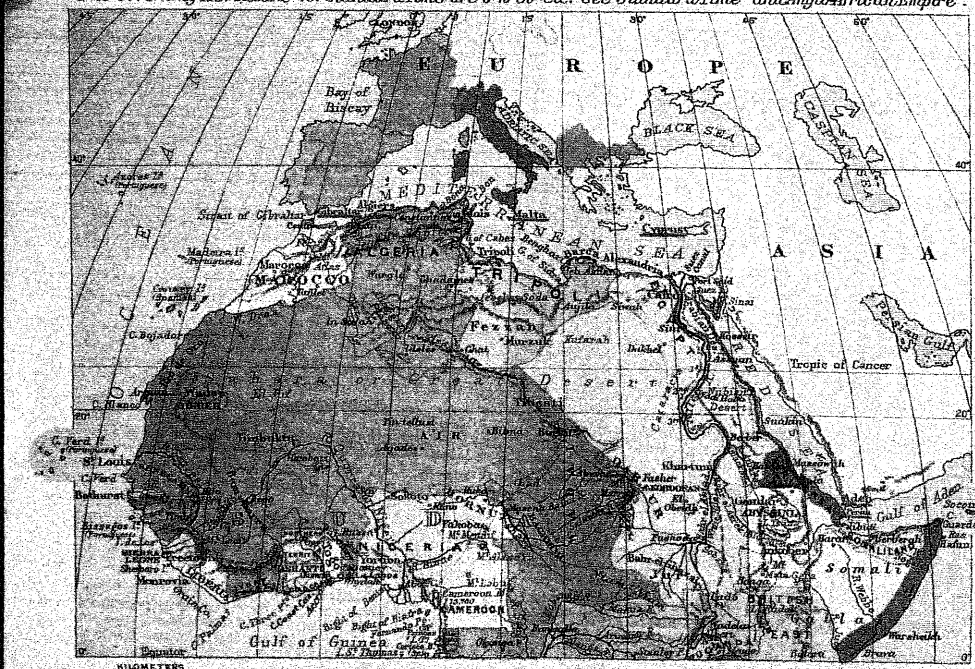
Almost form a

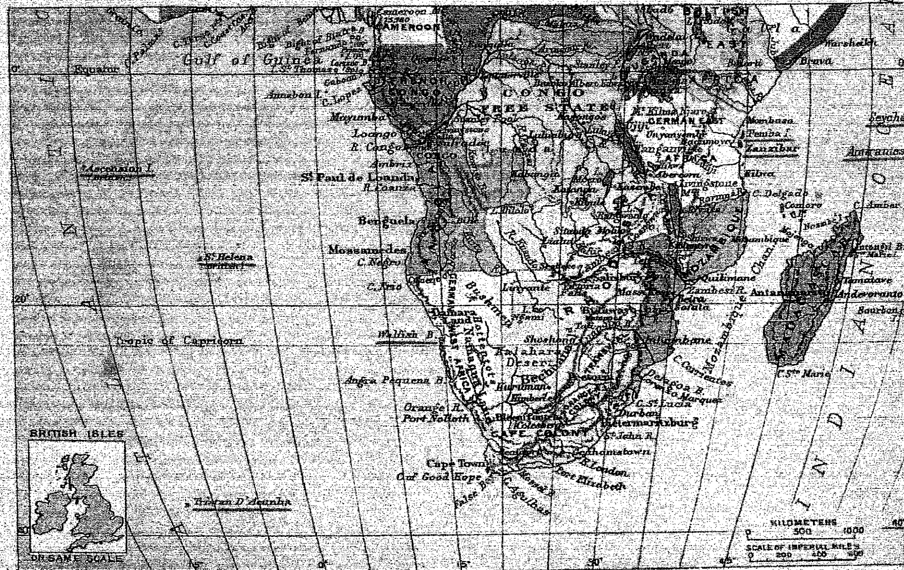
HORSE-SHOE ROUND THE INDIAN OCEAN

Their trade relations are harassed by three distinct types of weights and measures, and four standards of silver coinage.



This Map also indicates the lines on which the greater part of our scattered Empire is destined to become consolidated, for it shows at a glance what countries are still open for acquisition by absorption or purchase, or by exchange with other countries, to make a continuous stretch of British Territories from Cape Town to Singapore. So important is this "connecting-up" or "horse-shoe" policy to India and Egypt, that Great Britain should be ready, whenever necessary, to apply the principles of the Monroe Doctrine to the Seaboards of Arabia and Persia.


The Governing Meridians for Standard Time are 0° 15° 30° etc. See "Standard Time" and "Anglo-African Empire".
EUROPE
ASIA
MEDITERRANEAN SEA
BLACK SEA
CASPIAN SEA
ALGERIA
TRIPOLI
MOROCCO
Fezzan
Sahara Desert
Arabian Desert
Nubian Desert
Libyan Desert
Tropic of Cancer
Equator
Gulf of Guinea
Gulf of Aden
Persian Gulf
Red Sea
Bay of Biscay
Strait of Gibraltar
NIGERIA
CAMEROON
Somali
Abyssinia
Suez Canal
KILOMETERS
0 500 1000
SCALE OF IMPERIAL MILES
0 250 500 600
British
French
Belgian
German
Portuguese
Turkish
Italian
Spanish



British ... German ... Italian ...

French ... Portuguese ... Spanish ...

Belgian ...

THE UNION FLAG.

The banner of *St. George* formed the colours of the Plantagenet Kings, a white flag with a plain red cross, the arms of which are at right angles to the sides of the flag.

The banner of *St. Andrew* was a white saltire, or diagonal cross, on a blue field.

In 1707, at the union of the English and Scottish crowns, these flags were combined, the red cross being fimbriated (*i.e.*, merely fringed with the white border) and laid upon St. Andrew's banner. This flag was known as the "Jack," because it was ordered by the first King of Great Britain (James VI. of Scotland, I. of England), whose signature was always "Jacques."

In 1801, at the union of Great Britain and Ireland, the banner of *St. Patrick*—a narrow red saltire or diagonal cross on a white field—was fimbriated and laid upon the banner of St. Andrew, and upon these the fimbriated cross of St. George was laid. But the white margin of the Irish red cross was not made uniform throughout, because, on the analogy of the uniform margin of the English red cross, that would have indicated only the original white ground of the Irish Saltire, and would thereby have obliterated the Scotch white saltire altogether, leaving only the blue ground in the angles to indicate the original national flag of Scotland. It was accordingly provided that in the two "cantons" or quarters of the flag nearest the staff the upper white margin of the combined saltires should be much wider than the lower, this order being reversed in the two outer cantons. This flag is called the "Union Jack." No Union Jack is properly constructed unless this arrangement is scrupulously respected, nor is any such flag properly proportioned, according to established usage and prescription, unless the length or "fly" of the flag is twice as great as its height or "hoist." There are other niceties of construction, such as the precise point at which the combined saltires of St. Andrew and St. Patrick should intersect the cross of St. George; but as some latitude of usage seems to be tolerated in these respects—indeed the authorities are not quite unanimous about them—they need not be described in detail.

In the Royal Navy the Union flag is plain, but in the Merchant Service it must have a white border. When this latter is flown from the mast-head it is a signal for a pilot, and is called the "Pilot Jack."

A TABLE OF THE KINGS AND QUEENS OF ENGLAND

From 827 to the Present Time.

Saxons and Danes.

Egbert	827	Edwy	955
Ethelwulf...	839	Edgar	958
Ethelbald }	858	Edward the Martyr ...	975
Ethelbert }		Ethelred II.	979
Ethelred	866	Edmund Ironside ...	1016
Alfred	871	Canute	1017
Edward the Elder ...	901	Harold I.	1035
Athelstan	925	Hardicanute	1040
Edmund	940	Edward the Confessor...	1042
Edred	946	Harold II.	1066

The House of Normandy.

William I.	1066	Henry I.	1100
William II.	1087	Stephen	1135

The House of Plantagenet.

Henry II.	1154	Edward I.	1272
Richard I.	1189	Edward II.	1307
John	1199	Edward III.	1327
Henry III.	1216	Richard II.	1377

The House of Lancaster.

Henry IV.	1399	Henry VI.	1422
Henry V.	1413		

The House of York.

Edward IV.	1461	Richard III.	1483
Edward V.	1483		

The House of Tudor.

Henry VII.	1485	Mary I.	1553
Henry VIII.	1509	Elizabeth	1558
Edward VI.	1547		

The House of Stuart.

James I. *	1603	Charles I.	1625

Commonwealth.

Declared May 19 ...	1649	Richard Cromwell L. Protector	1658
Oliver Cromwell Lord Protector	1653	Richard Cromwell resigned	1659

T House of Stuart Restored.

Charles II.	1660	James II.	1685
Interregnum Dec. 11, 1688—Feb 13, 1689.			
William III. and Mary II. (Mary died 1694)	1689	Anne	1702

The House of Hanover.

George I.	1714	George IV.	1820
George II.	1727	William IV.	1830
George III.	1760	Victoria †	1837

The House of Saxe-Coburg.

Edward VII. ... ... 1901 Whom God preserve.

---

* James I. of England and VI. of Scotland. Since James's time the Crowns of England and Scotland have been united, but the Parliaments were not one until the Act of Union in 1707. The Parliaments of Great Britain and Ireland were united on 1st Jan., 1801.

† Empress of India, 1st May, 1876.

THE KING AND ROYAL FAMILY.

His Majesty Edward VII., by the Grace of God, of the United Kingdom of Great Britain and Ireland and of all the British Dominions beyond the Seas, King, Defender of the Faith, Emperor of India *; eldest son of Queen Victoria and Prince Albert of Saxe-Coburg and Gotha; *b.* November 9th, 1841; *m.* March 10th, 1863, to the Princess Alexandra (*b.* December 1st, 1844), eldest daughter of the King of Denmark; succeeded to the throne January 22nd, 1901; has one son and three daughters living.

1. George Frederick, Prince of Wales, Duke of Cornwall and York; Vice-Admiral of the Royal Navy; *b.* June 3rd, 1865; *m.* July 6th, 1893, to the Princess Victoria Mary ("May") of Teck; has five children—four sons and one daughter:— (i.) Edward, *b.* 1894; (ii.) Albert, *b.* 1895; (iii.) Victoria, *b.* 1897; (iv.) Henry, *b.* 1900; (v.) George, *b.* 1902.
2. Louise, *b.* February 20th, 1867; *m.* July 27th, 1889, to Duke of Fife; has two daughters (i.) Alexandra, *b.* 1891; (ii.) Maud *b.* 1893.
3. Victoria, *b.* July 6th, 1868.
4. Maud, *b.* November 26th, 1869; *m.* July 22nd, 1896, to H.R.H. Prince Charles of Denmark.

THE IMPERIAL PARLIAMENT.

In England and Wales,	about every	66,000	of population have	1	Member.
„ Scotland	„	63,000	„	1	„
„ Ireland	„	44,000	„	1	„

There are 670 Members returned in all, namely by Great Britain 567 and Ireland 103. Nearly one-half of these, drawn from all parties, are in favour of a Bill for the general adoption of the Metric System.

* India here means that portion governed by Native Princes, under British suzerainty; over "British" India our King rules as King, hence the term King-Emperor.

A FEW ABBREVIATIONS.

%, per cent.; @, at; *a/c*, account; *c/s*, case or case of; °, degree of an arc or thermometer; ′, minute of an arc *or* foot lineal; ″, seconds of an arc *or* inch lineal; *m.*, minutes of time; *s.*, seconds of time; *broad arrow*,  , Government mark for solids; *crow's foot* or *bench mark*,  , indicates surveying levels taken at that spot.

advt., advertisement.
ansd., answered.
A 1, first class, best quality.
B.L., bill of lading.
C. or *Cap.* or *Chap.*, chapter (Act of Parl.).
contd., continued.
cq., cheque.
C.O.D., collect on delivery.
Cr., credit, creditor.
Dr., debit, debitor.
Ditto, or *do.*, the same.
e.e., errors excepted.
e. and o.e., errors and omissions excepted.
e.g., for example.
etc., and the rest, and so on.
et. seq., and the following, and what follows.
ex., example.
fig., figure.
f.o.b., free on board.
Forwd., brought or carried forward.
ib., *ibid.*, in the same place.
i.e., that is to say.
inf., *infra.*, see below.
inst., the present month.
int., interest.
in trans., on the passage.
I.O.U., I owe you.
L.S. (locus sigilli), the place of the seal.
Memo., memorandum.
Memos., memoranda.
MS., manuscript; Plural, *MSS.*
N.B., note well.
nem. con., without opposition.
non. seq., it does not follow.
O.K., all correct.
pd., paid.
p., page.
pp., pages.
p.p., *per pro.*, in the place of.
par., *para.*, paragraph.
per annum, by the year.
pro. tem., for the time being.
prox., the next month.
P.P.C., (pour prendre congé), to take leave.
PS., after written.
P.T.O., please turn over.
Q., *qy.*, or *?*, query.
q.q. (see next page).
qr., quarter.
qty., quantity.
Q.V. (quod vide), which see
re., in the matter of.

recd., received.
retd., returned.
R.S.V.P., answer if you please.
sic., if it can be so expressed.
s.s., steam ship.
s.v., sailing ship or vessel.
stet., let it stand.
sup. or *supra.*, see above.
ult., the month immediately past.
v., versus.
vid. or *vide.*, see.
viz., namely, to wit.
W.P., weather permitting.

Q.q. (qualitate quæ), Roman-Dutch-Law idiomatic phrase, signifying that a person so signing is acting for a principal named or unnamed, usually the latter.

A FEW MATHEMATICAL SIGNS, &c.

\+ Plus, addition.
— Minus, subtraction.
× By, multiplied by.
÷ Divided by.
1 : 2 :: 4 : 8 Signifies as 1 is to 2, so is 4 to 8.
$3 \div 10 = \frac{3}{10} = .3$
$3 \div 9 = \frac{3}{9} = .3$
In the fraction $\frac{3}{10}$, 3 is called the dividend or numerator, and 10 the divisor or denominator.
Numbers appearing within brackets, or with a line drawn over them, are to be regarded as one quantity.
$\sqrt{}$ Square root.
$\sqrt[3]{}$ Cube root.
$\Subset$ Is contained in.
= Equals, equal to, becomes.
$\neq$ Unequal to.
$\parallel$ Parallel to.
$\nparallel$ Not Parallel.
$\therefore$ Therefore.
$\because$ Because.
$>$ Greater than.
$<$ Less than.
$\ngtr$ Not greater than.
$\nless$ Not less than.
$\perp$ Perpendicular to.
$\angle$ Angle.
$\llcorner$ Right angle.
Δ Triangle.
$\square$ Square.
$\square$ Parallelogram.
π Ratio of circumference of a circle to diameter.
$\bigcirc$ Circumference.
$\odot$ Circle.
$\bigcirc\!\!\!\!\!\!\supset$ Semi-circle.
$\bigcirc\!\!\!\!\!\!\supset$ Quadrant.
$\frown$ Arc.
∞ Infinity.
$\propto$ Varies as.
δ Variation, declination.
λ Latitude.
ϕ Any angle.
θ Any angle.
Log., Logarithm.

SIZES OF GROUNDS, &c.

(Outdoor Games.)

GENERAL REMARKS.

The idea of this little book is to encourage the adoption throughout the Empire of the "Metric Decimal System of Measures, &c." and if athletes used the Metric Measurements for their Games and Sports, they would be helping on a great Imperial movement by making the measures familiar to us all, in an agreeable way.

In marking out grounds the proportion of the various measurements to one another is at once apparent by the Metric measures, and more easily carried in the memory than if the present measures are used; thus, an Association Football Ground would be 100 meters by 75 meters, with a goal width of 7·5 meters and goal height of 2·5 meters, and so on, instead of mixing up yards, feet, and inches.

Plans of grounds are therefore given in duplicate, one copy showing the present Imperial, and the other, the *suggested* Metric denominations for experts to consider, or improve upon.

CRICKET.

Recognised Authority: The Marylebone Cricket Club (M.C.C.)

Secretary, F. E. Lacey, Esq., 29, Cavendish Road West, London, N.W.

By the 1903 rules:—

The wickets shall be pitched opposite and parallel to each other, at a distance of 22 yards (= 20·1 meters, say 20 meters).

Each wicket shall be 8 in. (= 2 decimeters) in width.

The bowling crease shall be in a line with the stumps ; 8 ft. 8 in. (= 2½ meters) in length ; the stumps in the centre ; with a return crease at each end, at right angles behind the wicket.

The popping crease shall be marked 4 ft. (= 12 decimeters) from the wicket, parallel to it, and be deemed unlimited in length.

The stumps shall be 27 in. out of ground, and the bails shall not project more than ½ in. above them, *i.e.*, 27½ in. in all (= 7 decimeters).

Each bail shall be 4 in. (= 1 decimeter) long.

ASSOCIATION FOOTBALL.

Recognised Authority : The Football Association.

Secretary, F. J. Wall, Esq., 104, High Holborn, London, W.C.

By the 1903–4 rules :—

The field of play shall be :—Maximum length, 130 yards ; minimum length, 100 yards ; maximum breadth, 100 yards ; minimum breadth, 50 yards.

The field of play shall be marked by boundary lines ; the lines at each end are the goal lines and the lines at the sides are the touch lines ; the touch lines shall be drawn at right angles to the goal lines. A flag with a staff not less than 5 ft. high shall be placed at each corner. A half-way line shall be marked out across the field of play, and its centre shall be indicated by a suitable mark ; a circle with a 10 yards' radius shall be made round it.

The goal shall be upright posts fixed on the goal lines, equidistant from the corner flag-staffs, 8 yards apart, with a bar across them, 8 feet from the ground. The maximum width of the goal-posts and the maximum depth of the cross-bar shall be 5 inches.

6 Yards from each goal post, lines shall be drawn at right angles to the goal line, for a distance of 6 yards, and the extremities of these lines shall be joined by a line 20 yards long, parallel to the goal line. The space thus enclosed shall be called the "Goal Area."

18 Yards from each goal post, lines shall be drawn at right angles to the goal line, for a distance of 18 yards, and the extremities of these lines shall be joined by a line 44 yards long, parallel to the goal line. The space thus enclosed (excluding the Goal area) shall be called the "Penalty Area."

12 Yards in front of the centre of the goal a mark shall be made called the "Penalty-kick Mark."

In International matches, the dimensions of the field of play shall be :—Maximum length, 120 yards ; minimum length, 110 yards ; maximum breadth, 80 yards ; minimum breadth 70 yards.

For Plans see pages 238 and 239.

RUGBY.

Recognised Authority : The Rugby Football Union.

Hon. Secretary, G. Rowland Hill, Esq., 5, Danes Inn, Strand, London, W.C.

By the 1903-4 rules :—

The field of play shall not exceed 110 yards in length, nor 75 yards in breadth, and shall be as near these dimensions as practicable, with a flag at each corner.

The lines defining the boundaries of the field shall be suitably marked : the lines at each end are the goal lines, and the lines at the sides are the touch lines : the touch lines shall be drawn at right angles to the goal lines.

The goals shall be upright posts exceeding 11 ft. in height, fixed on the goal lines, equi-distant from the corner flag-staffs, 18 ft. 6 in. apart, and joined by a cross-bar 10 ft. from the ground.

Lines defining 25 yards from the front of the goal lines, a half-way line, and "dead-ball lines" may also be marked out, the latter not more than 25 yards behind the goal lines, and the touch lines produced to them.

The centre of the field of play can be indicated by a suitable mark, and a circle with a 10 yards' radius may be made round it.

(The two latter paragraphs refer to the method of marking out grounds in South Africa, and are not mentioned in the By-Laws of the Rugby Football Union.)

For Plans see pages 240 and 241.

HOCKEY.

Recognised Authority: The Hockey Association.

Hon. Sec.: A. Frampton, Esq., Woodlawn, Teddington.

By the 1903–4 rules :—

The field of play shall be 100 yards in length, and not more than 60 yards nor less than 50 yards in breadth, with a flag at each corner.

The lines defining the boundaries of the field shall be suitably marked: the lines at each end are the goal lines, and the lines at the sides are the touch lines: the touch lines shall be drawn at right angles to the goal lines.

Lines defining 25 yards from the front of the goal lines (called *bully* lines) and a half-way line shall be marked out.

The centre of the field of play shall be indicated by a suitable mark.

The goals shall be 2 in. square upright posts, fixed on the goal lines, equi-distant from the corner flag-staffs, 12 ft. apart, and joined by a cross bar 7 ft. from the ground.

In front of each goal shall be drawn a line 12 ft. long, parallel to the goal line, and 15 yards from it: the ends of this line shall be curved round to the goal lines by quarter circles, of which the goal posts form the centres: this line to be called the *striking circle.*

Parallel to the touch lines and 5 yards therefrom, should be drawn two dotted lines, the length of the field of play, called the 5-*yard lines.*

Small quarter circles, 3 yards radius, may also be drawn at each corner of the field for the corner hits.

For Plans see pages 242 and 243.

LAWN TENNIS.

Recognised Authority: The Lawn Tennis Association.

Hon. Sec: G. R. Mewburn, Esq., B.A., 33, Old Broad Street, London, E.C.

By the 1903 Rules:—

The Court is divided across the middle by a net, the ends of which are attached to the tops of two posts, which stand 3 ft. outside the Court on each side.

The height of the net is 3 ft. 6 in. at the posts, and 3 ft. at the centre.

The marking of the part of the Half-Court line between the Service-lines and the Base-lines may be omitted, with the exception of a small portion at the centre of each Base-line, as indicated in the plans.

The following suggestions are made for adopting the Metric Measurements:—The net ½ in. lower, and the Half-Court shortened in proportion (about 3½ in.) and decreased in width about 2 in.; the total length of Courts increased about 4½ in. each end, and the total width for the three or four-handed game increased 1 in.

For Plans and Measurements see pages 244 to 247.

CROQUET.

Recognised Authority: The United All-England Croquet Association, Wimbledon.

By the 1903 Rules:—

The dimensions of a full-sized Croquet Ground shall be 35 yards in length and 28 yards in breadth, within a boundary line accurately defined.

Smaller grounds should be made in the same proportion, *i.e.*, any multiple of 5 by 4 (30 × 24; 25 × 20; 20 × 16).

A spot of whitening shall be placed accurately at each corner, 3 ft. from both boundaries (or thin or dotted lines may be drawn parallel to and 3 ft. within the dead boundary lines), also on the starting point.

The uprights of the hoops shall be 4 in. (= 1 decimeter) apart, inside measurement, and the hoops shall be 12 in. (= 3 decimeters) out of the ground; the pegs 2 ft. (= 6 decimeters), upright and firm

Measurements on a full-sized ground :—

Pegs in centre line of ground, 7 yards from nearest boundary.
Hoops up centre line of ground, 7 yards from pegs and 7 yards apart.
Corner hoops, 7 yards from and in line with the pegs.

If Metric Measurements were used, and the length of the ground to the width were as 4 is to 3 instead of as 5 is to 4, a full-sized ground would be 32 meters by 24 meters ; and the pegs could be 8 meters from the nearest boundary ; and the hoops up centre line of ground 6 meters from pegs and 6 meters apart. The corner hoops, 6 meters from and in line with the pegs.

Already, the uprights of the hoop are 1 decimeter apart, with the cross-bar 3 decimeters above ground, and the pegs 6 decimeters.

For Plan, and Order of making Hoops and Pegs, see next page.

WATER POLO.

Recognised Authority : The Amateur Swimming Association.* Hon. Sec. G. W. Hearn, Esq., Ladymeade, Walliscourt Road, Weston-Super-Mare.

By the 1903 rules :—

The distance between the goals shall not exceed 30 yards, nor be less than 19 yards ; the width shall not be more than 20 yards, and shall be of even width throughout the field of play. In baths, the half-way line and also the 4 yards penalty lines shall be marked on both sides.

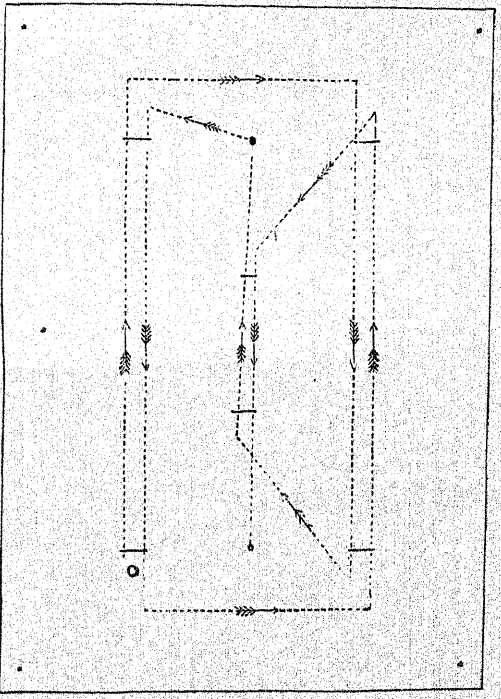
The goal posts shall be fixed at least one foot from the end of the bath, or any obstruction, and be 10 feet apart ; the cross-bar (or hanging rope from which the goal flags may be hung over running water) shall be 3 feet above the surface, when the water is 5 feet or over in depth, or 8 feet from the bottom when the water is less than 5 feet in depth (it should not be shallower in any part than 3 feet).

If Metric Measurements are used, for the word "yards" in the first paragraph read "meters" ; for 1 ft. read 3 decimeters ; for 10 ft., 3 meters ; 3 ft., 1 meter ; 5 ft., 1½ meters ; 8 ft., 2½ meters.

* A. S. A. Handbook, Boot and Son, Ltd., Fleet Lane, Old Bailey, London, E.C. 1s.

PLAN FOR MARKING OUT A CROQUET GROUND,

AND ORDER OF MAKING HOOPS AND PEGS.

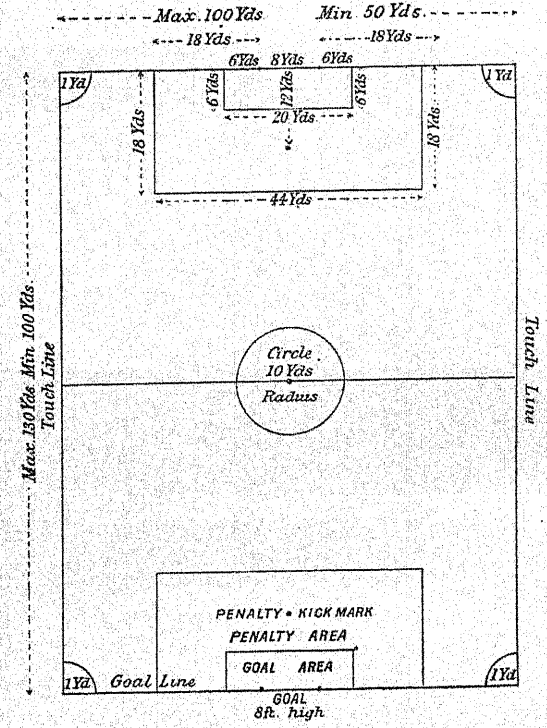


Starting point one foot (3 decimeters) from left-hand corner hoop, and opposite its centre.

For Metric and ordinary Measurements see page 235.

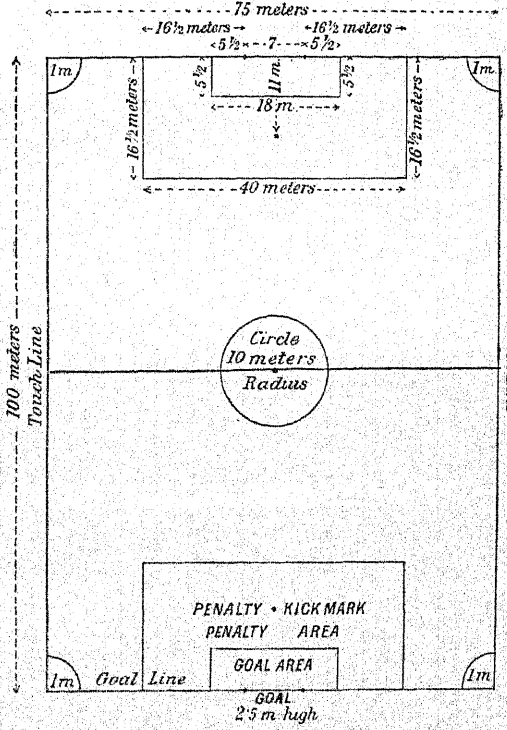
PLAN FOR MARKING OUT AN ASSOCIATION FOOTBALL GROUND.

In ordinary Imperial Measurements.



See opposite page and page 232.

PLAN FOR MARKING OUT
AN ASSOCIATION FOOTBALL GROUND
Practical Metric Measurements.

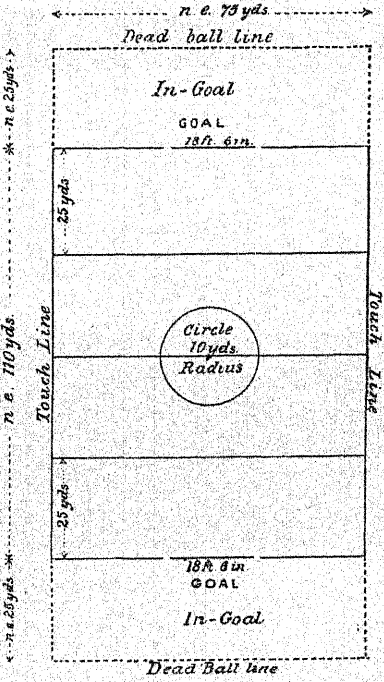


See opposite page and page 232.

PLAN FOR MARKING OUT
A RUGBY FOOTBALL GROUND.

In ordinary Imperial Measurements.

N.E. = Not exceeding.

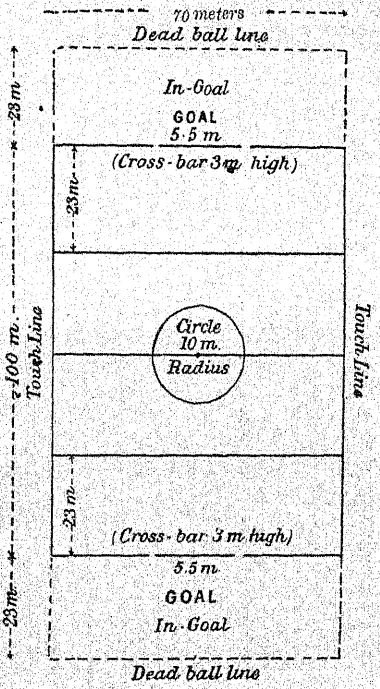


Goal cross-bar 10 ft. high.

See opposite page and page 233.

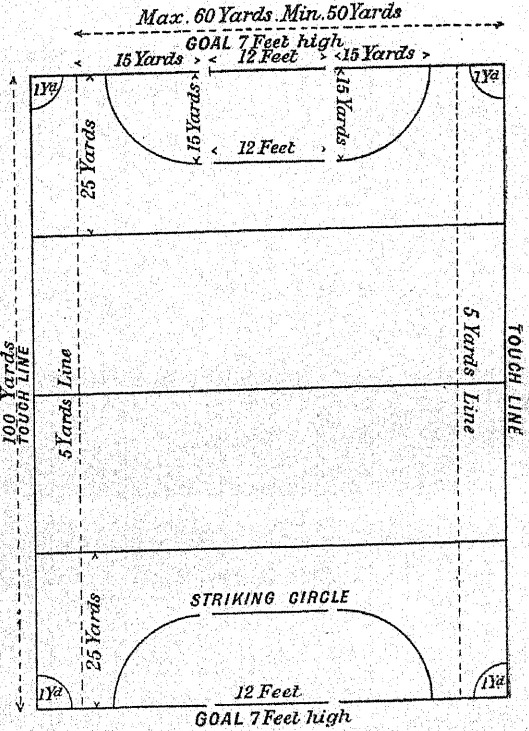
PLAN FOR MARKING OUT
A RUGBY FOOTBALL GROUND.

Practical Metric Measurements.



See opposite page and page 233.

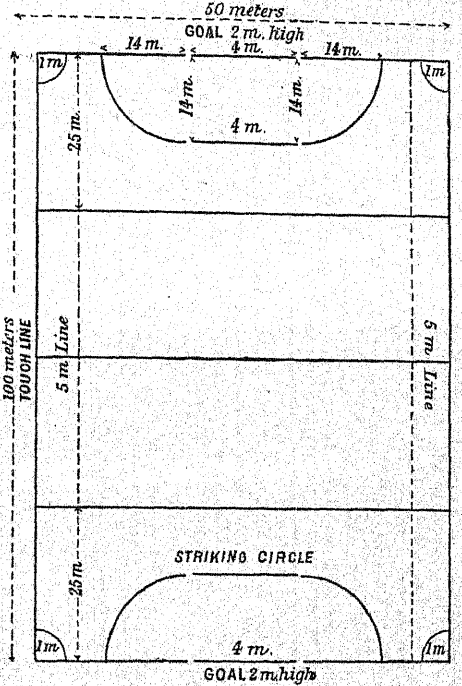
PLAN FOR MARKING OUT
A HOCKEY GROUND
In ordinary Imperial Measurements.



See opposite page and page 234.

PLAN FOR MARKING OUT A HOCKEY GROUND

Practical Metric Measurements.

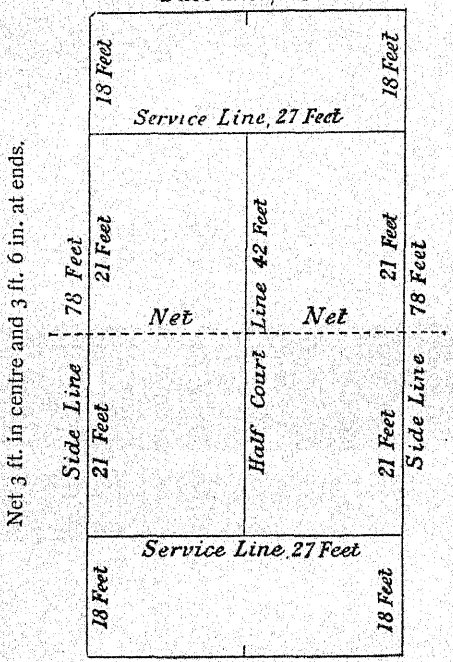


See opposite page and page 234.

PLAN FOR MARKING OUT A LAWN TENNIS COURT.

THE SINGLE-HANDED GAME.

In ordinary Imperial Measurements.

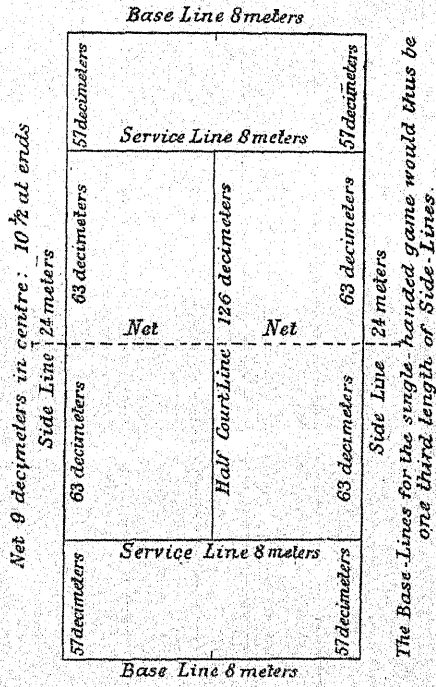


See opposite page and page 235.

PLAN FOR MARKING OUT A LAWN TENNIS COURT.

THE SINGLE-HANDED GAME.

Practical Metric Measurements suggested.

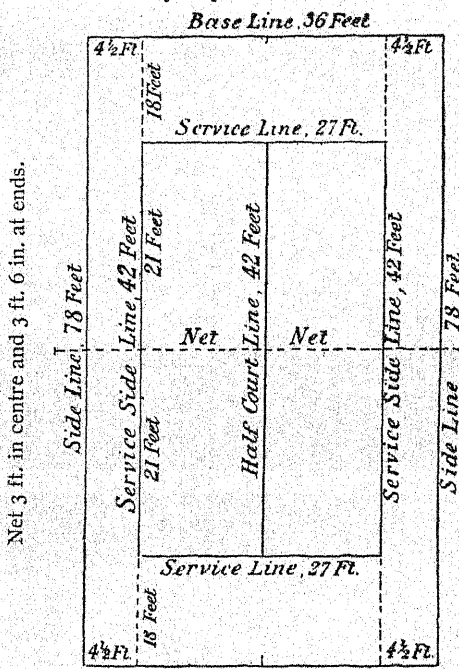


See opposite page and page 235.

PLAN FOR MARKING OUT A LAWN TENNIS COURT

THE THREE OR FOUR-HANDED GAME.

In ordinary Imperial Measurements.



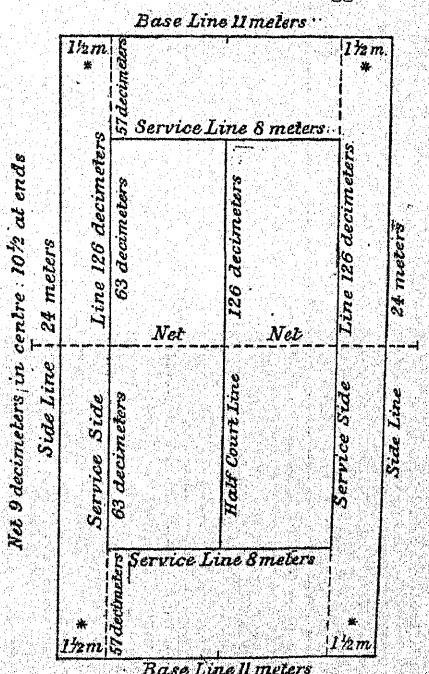
N.B.—By continuing the Service Side Lines to the Base Lines, as shown by the dotted lines above, this Court can be used for either the Single or the Double Game.

See opposite page and page 235.

PLAN FOR MARKING OUT A LAWN TENNIS COURT

THE THREE OR FOUR-HANDED GAME.

Practical Metric Measurements suggested.



* If these side measurements were 2 instead of 1½ meters, then the Base Lines for the four-handed game would be 12 meters, or one half-length of the Side Lines.

See opposite page and page 235.

INDEX

INDEX TO NAUTICAL INFORMATION.

S.S. Steamship. *S.V.* Sailing Ship or Vessel.

A SUPPLEMENT

TO

MARTIN'S UP-TO-DATE TABLES

FOR BEGINNERS

Is Published at **ONE PENNY;**

FOR USE IN SCHOOLS AND HOME TEACHING,

BEING

A GUIDE TO SIMPLE ARITHMETIC,

SHOWING HOW

DECIMALS can be taught at a VERY EARLY AGE,

AND CONTAINING, IN COMPACT FORM, ALL THE

TABLES TO BE LEARNT BY HEART,

AND A SHORT TREATISE ON BOOK-KEEPING.

LONDON:

T. FISHER UNWIN

11, PATERNOSTER BUILDINGS.

NOTE.—A "Gratis Copy" of the above Supplement is presented with each copy of this Book.

UNWIN BROTHERS, LIMITED, PRINTERS, WOKING AND LONDON.